PB-245 788

# GUIDELINES FOR QUALITY ASSURANCE PROGRAMS FOR MOBILE SOURCE EMISSIONS MEASUREMENT SYSTEMS: PHASE 1, LIGHT-DUTY GASOLINE-POWERED VEHICLES TEST PROCEDURES

Rod Pilkington, et al

Olson Laboratories, Incorporated

Prepared for:

National Environmental Research Center

June 1975

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE

301180

PB 245 788

EPA-650/4-75-024-b

June 1975

Environmental Monitoring Series

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

## TECHNICAL REPORT DATA
*(Please read Instructions on the reverse before completing)*

**1. REPORT NO.** EPA-650/4-75-024-b

**2.**

**3. RECIPIENT'S ACCESSION NO.**

**4. TITLE AND SUBTITLE**
Guidelines for QA Programs for Mobile Source Emissions Measurement Systems - Phase I, Light Duty Gasoline-Powered Vehicles - Test Procedures

**5. REPORT DATE** June 1975

**6. PERFORMING ORGANIZATION CODE**

**7. AUTHOR(S)**
Rod Pilkington, Tom Kelly and Harold Wimette

**8. PERFORMING ORGANIZATION REPORT NO.**

**9. PERFORMING ORGANIZATION NAME AND ADDRESS**
Olson Laboratories, Inc.
421 East Cerritos Avenue
Anaheim, California 92805

**10. PROGRAM ELEMENT NO.** 1HA327

**11. CONTRACT/GRANT NO.** 68-02-1740

**12. SPONSORING AGENCY NAME AND ADDRESS**
EPA, NERC, QAEML, QAS
Research Triangle Park
North Carolina 27711

**13. TYPE OF REPORT AND PERIOD COVERED** Final

**14. SPONSORING AGENCY CODE**

**15. SUPPLEMENTARY NOTES** This report is one of two volumes for Light Duty Gasoline-Powered Vehicles (Phase I). Other volumes are to be issued for Phase II Heavy Duty Diesel Engines, Phase III Light Duty Diesel-Powered Vehicles, and Phase IV Heavy Duty Gasoline Engines.

**16. ABSTRACT**

Test Procedures for Light Duty Gasoline-Powered Mobile Source Emissions Measurement Systems are presented with the concept of a total Quality Assurance System. The Test Procedures are presented in document control format and give the detailed test procedures with Quality Assurance provisions for each part of the total testing system.

**17. KEY WORDS AND DOCUMENT ANALYSIS**

| a. DESCRIPTORS | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group |
|---|---|---|
| Quality Control<br>Quality Assurance<br>Quantitative Analysis<br>Gas Analysis<br>Emissions - Exhaust Gases<br>Compliance Testing<br>Air Pollution | Mobile Source Emission Testing | 13H<br>14D<br>07D<br>13B |

**PRICES SUBJECT TO CHANGE**

**18. DISTRIBUTION STATEMENT**
Unlimited

**19. SECURITY CLASS (This Report)** Unclassified

**20. SECURITY CLASS (This page)** Unclassified

**21. NO. OF PAGES** 275

**22. PRICE** $8.50-2.25

EPA Form 2220-1 (9-73)

# GUIDELINE DISTRIBUTION RECORD

EPA-650/4-75-024-b "Guidelines for Quality Assurance Programs for Mobile Source Emissions Measurement Systems: Phase I, Light-Duty Gasoline-Powered Vehicles" - Test Procedures

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# GUIDELINES FOR QUALITY ASSURANCE PROGRAMS FOR MOBILE SOURCE EMISSIONS MEASUREMENT SYSTEMS:

## PHASE I, LIGHT-DUTY GASOLINE-POWERED VEHICLES - TEST PROCEDURES

by

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246

Contract No. 68-02-1740
ROAP No. 26BGC
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Office of Mobile Source Air Pollution Control

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Office of Research and Development
Washington, D. C. 20460

June 1975

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## EPA REVIEW NOTICE

This volume has been prepared by Olson Laboratories, Incorporated consistent with the Environmental Protection Agency Quality Assurance principles and concepts and with the Environmental Protection Agency Mobile Source Testing Practices at Ann Arbor, Michigan.

The guidelines and procedures are generally applicable to mobile source testing operations and are intended for use by those engaged in such measurement programs

It is requested that recipients and users of this document submit any comments and suggestions to the Project Officers.

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Publication No. EPA-650/4-75-024-b

# INTRODUCTION

The test procedures contained in this volume are a documentation of the 1975 light-duty gasoline emission measurement test requirements presently in use at the Ann Arbor facility of the Environmental Protection Agency. These test procedures comply with Federal Regulations as stated in the Federal Register. (See Section 3, Volume I, for the listing of applicable Federal Registers).

Section 5, Volume I outlines the development of an Operations manual which may be used as a guideline for a Quality Assurance program. A typical format of a test procedures manual is described and offers a guide for implementing and interpreting the test procedures contained in Volume II. A user may wish to modify this format to suit specific contractual obligations or accept the manual in its present form. The user will be required to make revisions as needed to assure that the manual complies with Federal Regulations. Revisions may be implemented manually, by computer updates or by magnetic card storage.

For ease of use, the test procedures are separated into nine distinct sections, numbered 100-900. The table of contents shows the major heading of each section and the test procedures contained in each. To differentiate between the light-duty and heavy-duty testing which are both included in this contract, the test procedures are numbered to correspond to Light Duty, 101-149, 201-249, etc. and Heavy Duty, 150-199, 250-299, etc. Light-duty gasoline procedures modified for light-duty diesel applications are suffixed with a -D, e.g.TP-707-D.

To assist in defining the overall scope of the light-duty testing program, the tables from Section 3, Volume I, briefly outlining the test procedures, specifications and quality provisions are included in this introduction to the test procedures manual.

This document details test procedures for light-duty gasoline-powered vehicles and a subsequent volume will cover test procedures for heavy-duty diesel engines (Phase II) with a supplement covering heavy-duty gasoline engines (Phase IV). The test procedures for light duty diesel engines (Phase III) will appear as a supplement to the light-duty gasoline vehicle procedures detailed in this volume.

# TABLE OF CONTENTS

Page

Introduction . . . . . . . . . . . . . . . . . . . . . . . . . . iii

Section — Effective Date(s)

100 GAS BLENDING, FUEL ANALYSIS AND INVENTORY. . . . . . . . . .
101 Preparation of Binary Gas Mixtures . . . . . . . . . . . . .
102 Calibration of Gas Mixtures. . . . . . . . . . . . . . . . .

200 CALIBRATION. . . . . . . . . . . . . . . . . . . . . . . .
201 CVS Calibration. . . . . . . . . . . . . . . . . . . . . .
202 Dynamometer Calibration. . . . . . . . . . . . . . . . . .
203 Gas Analyzer Calibration Curve Generation. . . . . . . . .
204 Chart Recorder Calibration . . . . . . . . . . . . . . . .
205 Temperature Recorder Calibration . . . . . . . . . . . . .
206 Barometric Pressure Calibration and Correlation. . . . . .

300 VERIFICATION . . . . . . . . . . . . . . . . . . . . . . .
301 CVS System Verification by Tracer Gas Injection. . . . . .
302 Dynamometer Calibration Verification . . . . . . . . . . .
303 $NO_x$ Efficiency Check . . . . . . . . . . . . . . . . . .
304 $CO_2/H_2O$ Interference Check . . . . . . . . . . . . . . .

400 CORRELATION. . . . . . . . . . . . . . . . . . . . . . . .
401 Analyzer Cross Check . . . . . . . . . . . . . . . . . . .

500 MAINTENANCE. . . . . . . . . . . . . . . . . . . . . . . .

600 DAILY OPERATION. . . . . . . . . . . . . . . . . . . . . .
601 Log Book Entries . . . . . . . . . . . . . . . . . . . . .
602 Drift/Noise/Gain/Tune. . . . . . . . . . . . . . . . . . .
603 Test Vehicle Scheduling. . . . . . . . . . . . . . . . . .
604 Dynamometer Warm-Up/Set. . . . . . . . . . . . . . . . . .

700 EMISSION TESTING . . . . . . . . . . . . . . . . . . . . .
701 Test Vehicle Inspection and Acceptance . . . . . . . . . .
702 Evaporative Emission Preparation . . . . . . . . . . . . .
703 LA-4 Vehicle Preparation . . . . . . . . . . . . . . . . .
704 Test Vehicle Fueling . . . . . . . . . . . . . . . . . . .
705 Diurnal Evaporative Test . . . . . . . . . . . . . . . . .
706 1975 Urban Dynamometer Test - FTP. . . . . . . . . . . . .
707 Sample Analysis of 1975 FTP. . . . . . . . . . . . . . . .
708 Hot Soak Evaporative Test. . . . . . . . . . . . . . . . .
709 Vehicle De-Prep and Removal. . . . . . . . . . . . . . . .
710 Highway Fuel Economy Preconditioning . . . . . . . . . . .
711 Highway Fuel Economy Dyno Test - HWFET . . . . . . . . . .
712 Sample Analysis of HWFET . . . . . . . . . . . . . . . . .

800 DATA VALIDATION. . . . . . . . . . . . . . . . . . . . . .
801 Data Validation. . . . . . . . . . . . . . . . . . . . . .

900 PROGRAM PLANNING AND QUALITY AUDIT . . . . . . . . . . . .

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# LIST OF TABLES

Table | | Page
--- | --- | ---
1-1 | Federal Emission Test Procedure<br>Vehicle Preparation and Preconditioning . . . . . . . . . . | viii
1-2 | Federal Emission Test Procedure<br>Evaporative Emission Collection and Measurement . . . . . | x
1-3 | Federal Emission Test Procedure<br>Exhaust Emission Test . . . . . . . . . . . . . . . . . . . . | xii
1-4 | EPA Emission Measurement Facility Organization. . . . . . . | xv

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Table 1-1. FEDERAL EMISSION TEST PROCEDURE
Vehicle Preparation and Preconditioning

| PROCEDURE ITEM | RECEIVE VEHICLE | PRE-CONDITIONING AMA | DRIVEABILITY | VEHICLE INSPECTION | VEHICLE & ENGINE PREPARATION | TEST FUEL ADDED | PRE-CONDITIONING FEDERAL CYCLE | 11 HOUR AMBIENT SOAK |
|---|---|---|---|---|---|---|---|---|
| BRIEF DESCRIPTION | Visual inspection of test vehicle to verify vehicle and engine system integrity | All vehicles driven over same route to establish similar histories before test | To determine that veh. is operating satisfactorily, safely and can drive the federal cycle | To assure engine parameters are correctly set. Chk IDLE, CO, RPM, ignition timing dwell, centrifugal and vacuum advance | Leak proof fitting applied to all fuel systems. External vents to permit collection of emissions. Fuel system leak-checked. Install thermocouple & drain tank | Indolene 30<br>Indolene HO | The vehicle is driven on a dynamometer under controlled conditions | The vehicle is stored in a controlled environment |
| **FEDERAL REGISTER PARAGRAPHS** | 85.075-5,6,7 | 85.075-7,10, 12<br>Appendix IV | | | 85.075-11 | 85.075-10,11 | 85.075-12 | 85.075-13 |
| **EPA PROCEDURE NUMBER** | TP-701 | TP-702 | TP-702 | TP-701 | TP-702 | TP-702 | TP-703 | TP-703 |
| SPECIFICATIONS AND TOLERANCES | | | | | | | | |
| Federal Register | None | Driving Time-1 hour. Modified routes must be approved by the Administrator. Fuel-Tank fuel, unleaded fuel 0.02 grams of lead and 0.002 gm. phosphorus per gallon minimum. Leaded Fuel - 1.4 gm. lead per gallon, minimum | None | None | Fittings and tubing for canisters 5/16 I.D. | See above referenced paragraph for detailed specifications | Temp $77\pm9^{\circ}$F<br>Speed Tolerance ±4 MPH, ±1 sec.<br>Hot start is acceptable | 1st hour $81^{\circ}$ $\pm5^{\circ}$F. Followed by 10 hours $73^{\circ}$ $\pm13^{\circ}$F |
| Engineering Practice | Refer to manufacturers specific. for engine class | Urban route approved by Administrator | Correct malfunctions when possible | Manufacturers range or specification | Fuel system should lose not more than 2" $H_2O$ at 14" $H_2O$ in 5 min. | | | |

## Table 1-1. FEDERAL EMISSION TEST PROCEDURE
### Vehicle Preparation and Preconditioning
### (Continued)

| PROCEDURE ITEM | RECEIVE VEHICLE | PRE-CONDITIONING AMA | DRIVEABILITY | VEHICLE INSPECTION | VEHICLE & ENGINE PREPARATION | TEST FUEL ADDED | PRE-CONDITIONING FEDERAL CYCLE | 11 HOUR AMBIENT SOAK |
|---|---|---|---|---|---|---|---|---|
| QUALITY PROVISIONS | Inspection form completed and signed | | | Calibration of engine test equipment | | Color coded fuel pumps and vehicle tags and fuel inlets. Fuel analysis | Monitor temperature and inspection of drivers trace. Dyno Calibration | Monitor temperature in soak areas |
| TEST INVALID | Engine or vehicle parts missing or disconnected | Failure to complete route. Accident. | Engine malfunction, brake failure, vehicle unsafe. | Incorrect engine parameters | Failure to seal system. Fuel system leaks | Incorrect fuel added. Fuel out of specification | Temperature outside limits Drivers trace outside limits | Temperature outside limits Starting engine gine during soak |
| CORRECTIVE ACTION | Vehicle returned to manufacturer. | Reschedule vehicle. Repair or replace vehicle. | Return to manufacturer or supplier. | Adjust under manufacturers supervision | Return to manufacturer | Drain tank and refuel with correct fuel | Reschedule test | Reschedule vehicle. Correct temperature control. |
| TRAINING OR SKILL REQUIRED | Engine system training | Normal driving skills | Driveability characteristic training | Mechanic | Installation procedures training | None | Dynamometer cycle drivers training | None |
| RESPONSIBLE OPERATIONS | Receiving inspection<br>Production Control | Testing Operations | Testing Operations | Testing Operations<br>Support Operations | Testing Operations | Testing Operations<br>Support Operations | Testing Operations<br>Support Operations | Testing Operations<br>Building Maintenance |

Table 1-2. FEDERAL EMISSION TEST PROCEDURE
Evaporative Emission Collection and Measurement

| PROCEDURE ITEM | DRAIN FUEL | INSTALL CARBON CANISTER | ADD TEST FUEL | DIURNAL EVAP TEST HEAT BUILD | DYNAMOMETER PREPARATION | RUNNING LOSS TEST | 1 HOUR HOT SOAK LOSS | CANISTER WEIGHT |
|---|---|---|---|---|---|---|---|---|
| BRIEF DESCRIPTION | Residual fuel is drained from tank after 11 hour soak. | The carbon canister traps the emissions from the fuel system. Schematics A75-3, A75-4, A75-5, A75-6 | A specified test fuel with known composition is added to the tank, Indolene 30 or Indolene HO | Fuel vapors emitted as a result of a specific increase in fuel tank temperatures in a specified time are collected. Record ambient and fuel temperature | The vehicle is placed on the dynamometer without starting the engine and the necessary connections are made | Fuel vapors are collected during operation of the vehicle under the specified test schedule | **Fuel vapors are collected for 1 hour beginning immediately after the engine is turned off.** | **The collected vapors are determined by weighing the canister before and after the test.** |
| **FEDERAL REGISTER PARAGRAPHS** | 85.075-13 | 85.075-13, 21 | 85.002, 85.075-10, 13 | 85-075-13 | 85.075-13 | 85.075-13 | **85.075-13** | **85.075-27** |
| **EPA TEST PROCEDURE** | TP-702 | TP-702 | TP-702 | TP-705 | TP-604 | TP-706 | **TP-708** | **TP-708** |
| SPECIFICATIONS AND TOLERANCES | | | | | | | | |
| Federal Register | None | Capacity-300 ±2 ml. Length to diameter Ratio-1.4 ±0.1 Inlet and outlet tubes - 5/16 I.D., length 1 inch. leak tight at 2 PSI 30 sec., 150 ±10 gms. of charcoal conditioned at 300°F for 3 hours (1) | Charge 50-60°F Start 60 ±2°F End 84 ±2°F Time 60 ±10 min. Charge to 40% of nominal tank volume to nearest gallon | Temperature recorder, Range 50-100 ±1°F Thermocouple - Type J | Soak vehicle at 76-86°F for a min. of 1 hour before running loss test | See 1975 exhaust emission test Table 1.3 Vapors are not collected during 10 min soak or 505 second "hot" start test | **Ambient temp. 76-86°F** | **Weighing accuracy equip ±75 mg weight determined to 20 mg.** |
| Engineering Practice | Fuel pump cart of not more than 25 gallon capacity. Metts OSHA requirements. | | Heating rate 4 ±1.5°F Per 10 min. | Heating blanket 2000 watts to cover min. 50% of liquid fuel | Max. total soak time from key off to key on - 20 hours | See Table 1.3 | | Metler P1200 or equivalent Readability 0.01 gram |

(1) For more complete detail see Federal Register para. 85.075-21.

Table 1-2. FEDERAL EMISSION TEST PROCEDURE
Evaporative Emission Collection and Measurement
(Continued)

| PROCEDURE ITEM | DRAIN FUEL | INSTALL CARBON CANISTER | ADD TEST FUEL | DIURNAL EVAP TEST HEAT BUILD | DYNAMOMETER PREPARATION | RUNNING LOSS TEST | 1 HOUR HOT SOAK LOSS | CANISTER WEIGHT |
|---|---|---|---|---|---|---|---|---|
| QUALITY PROVISIONS | Check-off sheet signed by witness | Installation checked by team leader. Canister checked for leaks by comparing wt. before test with previous tare weight. | Ambient and fuel temp. Record checked by data validation (DV) step by step procedure check-off form signed by witness | | Ambient temp. and soak time by DV. | See Table 1.3 | Ambient temp. record checked by DV | Data checked by D.V. |
| TEST INVALID | Failure to drain tank. Starting engine. | Improper installation or canister leaks | Incorrect temperature, heating rate or time of heat application. | | Failure to preset dynomometer load or warm up dynanomometer Incorrect ambient temperature | Failure to follow driving cycle within prescribed tolerances. See also Table 1.3 | Failure to reconnect canisters after "hot" start test. Incorrect soak temp. | Negative weight gain is suspect. |
| CORRECTIVE ACTION | Reschedule | Correct installation. Reschedule if heat build had been started. | Reschedule | | Reschedule | Reschedule | Reschedule evap. only. | Reschedule using freshly dried or new canister |
| TRAINING OR SKILL REQUIRED | Basic knowledge of fuel system. | Familiarity with EPA approved installation for engine family | Basic knowledge of heating and temp measuring equipment. | | Knowledge of dyno procedures | Trained driver See Table 1.3 | Knowledge of canister installation | Knowledge of balance operation. |

Table 1-3. FEDERAL EMISSION TEST PROCEDURE
Exhaust Emission Test

| PROCEDURE ITEM | DYNO WARM-UP AND HP SETTING | CONSTANT VOLUME SAMPLER (CVS) | | DRIVING CYCLE | ANALYTICAL SYSTEM | | DATA COLLECTION | DATA REDUCTION |
|---|---|---|---|---|---|---|---|---|
| BRIEF DESCRIPTION | The vehicle is placed on the dynamometer which has been previously warmed up and the hp set | CALIBRATION:<br>The positive displacement pump is calibrated using a laminar flow element or equivalent. | OPERATION:<br>An integrated portion of the total exhaust-air mix is collected during the driving cycle along with a sample of dilution air. | A driving cycle typical of urban driving is performed on the dyno according to the FR driving schedule. | CALIBRATION:<br>Primary gas standards are used to establish the instrument curve | OPERATION:<br>The bag samples collected by the CVS are analyzed for CO, $CO_2$, HC and $NO_x$. | Ambient conditions are recorded along with instrument outputs and operating parameters. Vehicle and test cell identification and other pertinent information. | The grams per mile are calculated for each component using the formula in the FR |
| **FEDERAL REGISTER PARAGRAPH** | Appendix II<br>85.075-15 | Appendix III | 85.075-20,-24 | Appendix I<br>85.075-14,-15, -19,-24 | 85.075-23 | 85.075-23,-24 | 85.075-22,25 | 85.07-26 |
| **EPA PROCEDURE NUMBER** | TP-604 | TP-201 | TP-706 | TP-706 | TP-203 | TP-707,711 | TP-707 | TP-801 |
| **SPECIFICATIONS AND TOLERANCES**<br>Federal Register | Less than 2 hrs between tests - warm-up - 15 min @ 30 MPH within 1 hour of test. Hp setting - any time prior to test. For auto 1 hour prior for manual. Inflate tires to 45PSI. Use vehicle restraint to minimize rocking. | See Appendix III for equipment tolerances. Measure actual pump cavity pressure/temperature variation during calibration ±2°F gradual change. Leak-free connections. | CVS inlet pressure less than 1 in $H_2O$ Heat exchanger ±10 degrees of set point temp acc. ±2°F. Flow rate 300-350 cfm. Dilution filters consisting of a charcoal filter between two particulate filters Press. guage ±3 mm. Bag sample flow rate 10 cfh. min. Specific sampling procedure FR-24. | Horsepower setting - see FR-15. Fan 18-12 inches in front or to provide sufficient cooling. Driving trace precision - ±2 mph within 1 sec. Shift points - see FR-16-17. Engine shutdown at 1369 seconds. Time between cold and hot tests 10 ±1 minute Engine starting FR-19 Ambient Temp 68-86°F | Calibration performed every 30 days. Zero gas impurity:<br>1 ppm HC<br>1 ppm CO<br>400 ppm $CO_2$<br>0.1 ppm $NO_x$<br>$O_2$ 18-21 mole% (AIR)<br>Calibration Points:<br>HC & $NO_2$ 50 & 100%<br>CO & $CO_2$ - 10, 23, 40, 50, 60, 70, 80, 100% of full scale. Analysis of gas ±2% of actual value. Curve construction - best judgement. Analyzer warmup - HC - 20 min. CO, $CO_2$, $NO_x$ - 2 hours | Analysis performed within 20 minutes from end of sampling Zero and span instruments before and after sample measurement. Span gas should have conc of 80% of full scale. | All information is recorded according to measurement specifications. | Reported to three significant figures Density at 68° 1 atm.<br>HC 16.33<br>$NO_x$ 54.16<br>CO 32.97<br>$CO_2$ 51.85 |

## Table 1-3. FEDERAL EMISSION TEST PROCEDURE
Exhaust Emission Test
(Continued)

| PROCEDURE ITEM | DYNO WARM-UP AND HP SETTING | CONSTANT VOLUME SAMPLER (CVS) | | DRIVING CYCLE | ANALYTICAL SYSTEM | | DATA COLLECTION | DATA REDUCTION |
|---|---|---|---|---|---|---|---|---|
| SPECIFICATIONS AND TOLERANCES (Continued)<br>Engineering Practice | Allowable horsepower variation less than ±0.5 hp. | CALIBRATION: | OPERATION:<br>Tailpipe ±5 in $H_2O$. Sample mix temp. at pump inlet 90-115°F Heat exchanger ±5°F of set point.<br>Dilution inlet air 65°F min.<br>P.70" $H_2O$ max.<br>Bag construction 5 $f^3$ tedlar film. | Preprinted or computer traced driving schedule. A minimum of 12 hour and maximum of 20 hour soak from key off to key on. | Calibration points: CO, $CO_2$ 5 points & 0 across each range. Curve construction - within ±2% of each point value, smooth curve passing through zero (origin).<br>Weekly calibration check. | Digital voltmeter readings of instrument output recorded on chart. Zero repeated after each span adjustment | | NO and $NO_2$ reported separately corrected and uncorrected. |
| **QUALITY CONTROL PROVISIONS** | Calibration performed monthly with weekly checks. Correct setting for vehicle weight checked by data validation (DV). Time of previous test run is checked for dyno warm-up requirement. | Propane injection must agree within ±2% of calculated value. Daily propane injections plotted on control charts. Internal check of calibration data for uniformity. | Weekly performance checks of equipment Specifications DV checks each test for out-of-control operating conditions. | DV checks speed, time, trace, crank, time, amb. temp and all recorded information. Daily span check of driving aid. Driver performance audit. | Calibration gas analysis traceable to EPA gravimetric blends and/or NBS-SRM's. Inter-laboratory gas cross check. Annual restandardization of gases. Monthly instrument performance checks. CVS gravimetric injections. | Bags are leak checked before each test. $NO_x$ converter efficiency check performed daily Analytical system given monthly performance inspection and preventative maintenance recorder checked against DVM each test. | DV inspects all recorded information for spurious results and facilitates the smooth and timely flow of test documentation. | Data reduction is usually performed by computer. Manual or independent check of the reduction program should be performed monthly & whenever change in program. Computer output checked by DV for corrections. |

## Table 1-3. FEDERAL EMISSION TEST PROCEDURE

Exhaust Emission Test
(Continued)

| PROCEDURE ITEM | DYNO WARM-UP AND HP SETTING | CONSTANT VOLUME SAMPLER (CVS) | | DRIVING CYCLE | ANALYTICAL SYSTEM | | DATA COLLECTION | DATA REDUCTION |
|---|---|---|---|---|---|---|---|---|
| TEST INVALID | Failure to warmup dyno. Incorrect hp setting for weight. Vehicle exhaust not connected to CVS. | Calibration invalid if propane injection out of spec. | CVS flow rate too low - incorrect pump speed used. Equipment failure or out of spec. Filters plugged. | Driver outside specified limits during cycle. Improper starting - stalling procedure. Out of spec time sequence. Soak period to long or short. | Incorrect Standards or data used to construct curves. | Leak in sample bag detected may invalidate previous test. Incorrect span setting instrument malfunction such as span drift. | Incorrect data or information | Computer program or data input incorrect. |
| CORRECTIVE ACTION | Reschedule | Repeat propane injection. Refer to Appendix III for trouble shooting. Repeat calibration. | Reschedule | Reschedule Driver performance audit may be necessary | Repeat calibration. Generate new curve when data points out by more than ±0.5% deflection. | Repair or replace sample bag. Reschedule previous test. Reschedule if equipment failure occurs. | Correct information when possible. Report all data and information errors. Reschedule if data is not correctable | Correct program or data input and repeat calculation. |
| TRAINING OR SKILL REQUIRED | Dyno operation | Special training in use of calibration equipment. Experience in emission testing. | Special training in CVS operation. Familiar with other test equipment and procedures. | Trained in special driving skills required | Special training in calibration procedure. Previous experience as system operator desirable. | Training in analytical system operation. Knowledge of test procedures | Data validation should be familiar with test procedure, basic statistical and technical knowledge is desirable. | Computer programing capability required if done in-house. Computer operations training. |

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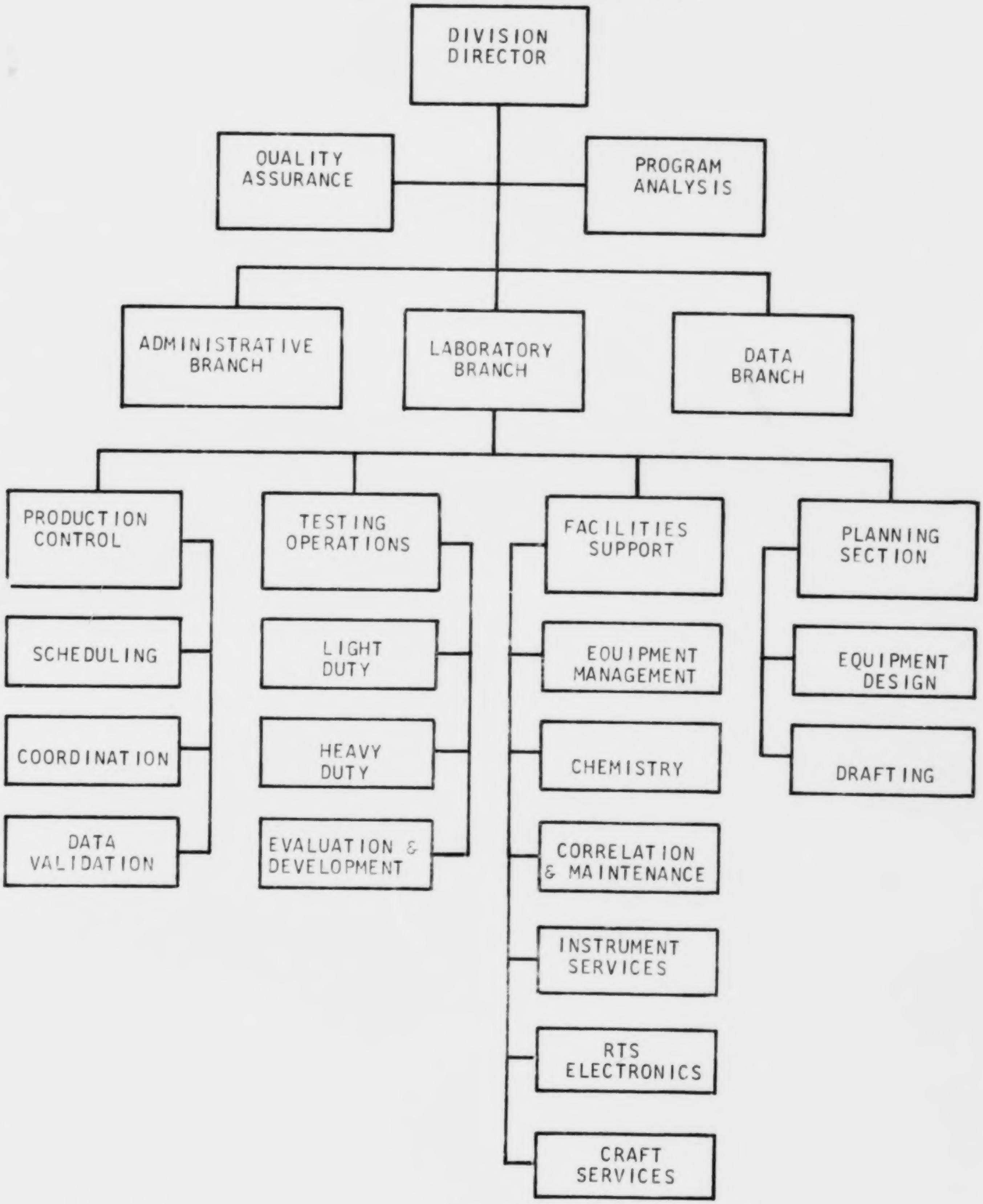
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HEAVY DUTY
EVALUATION & DEVELOPMENT
FACILITIES SUPPORT
EQUIPMENT MANAGEMENT
CHEMISTRY
CORRELATION & MAINTENANCE
INSTRUMENT SERVICES
RTS ELECTRONICS
CRAFT SERVICES
PLANNING SECTION
EQUIPMENT DESIGN
DRAFTING

Table 1-4

# Section 100

# GAS BLENDING, FUEL ANALYSIS AND INVENTORY

## EPA TEST PROCEDURE

| | | |
|---|---|---|
| | Number<br>TP-101 | Page 1 of 10 |

SUBJECT
PREPARATION OF GRAVIMETRIC BINARY GAS MIXTURES

| | |
|---|---|
| Reference<br>C. D. PAULSELL DRAFT 8/1/73 | Data Form No.<br>101-01, 02 |
| Responsible Organization<br>CHEMICAL ANALYSIS | Computer Program<br>CYLBLEND |
| Test Witness<br>QUALITY ASSURANCE REVIEW/REQUESTOR | Performance Interval<br>AS REQUESTED |
| Type of Test Report<br>GAS BLEND DATA SHEET | Supersedes<br>NEW |
| Report Distribution<br>QUAL. ASSUR., CORR. & MAINT., INST. SERV. | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| PROGRAM MGNT | QUALITY ASSURANCE | | |
| LAB. BRANCH | CHIEF | | |
| LAB. BRANCH | SUPP. OPERATIONS CHIEF | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

## 1.0 PURPOSE

This procedure outlines the equipment, blending process, and calculations necessary to generate binary gravimetric gas mixtures to be used as primary standards. The gravimetric technique is considered to be the most accurate method for the quantification of gases. Since the final data reported for emission measurement is in mass units it is of great importance that the primary standards be determined by mass rather than pressure or volumetric relationships.

## 2.0 TEST ARTICLE DESCRIPTION

Binary mixtures are prepared from pure components or blending mixtures of propane ($C_3H_8$), carbon monoxide (CO), carbon dioxide ($CO_2$) and nitric oxide (NO). Dilution of these gases is done with pure nitrogen or air.

## 3.0 REFERENCES

3.1 Procedure For Making Gravimetric Binary Gas Mixtures. EPA, C.D. Paulsell, 8/1/73.

3.2 Matheson Gas Data Book

3.3 "The Present State of The Art In The Preparation of Gaseous Standards", Scientific Gas Products, Inc.

3.4 "Handbook of Compressed Gases", Compressed Gas Assoc., Inc. Reinhold Publishing Corp., New York, N.Y.

## 4.0 REQUIRED EQUIPMENT

| | | |
|---|---|---|
| 4.1 | Cylinders: | Marison 1CC3AA1800 Carbon Steel<br>5.25" O.D. x 13.75" Length Volume -<br>223 Cubic Inches |
| | | Stainless Steel $NO_x$ Cylinders<br>3.75" O.D. x 13.0" Length<br>Volume - 110 Cubic inches |
| 4.2 | Valves: | Brass, Sherwood Selpac B<br>G-5 3540 F9 CGA350 |
| | | Stainless Steel Superior<br>CGA 660SS |
| 4.3 | Balance: | Voland Model 1115 CDN<br>10Kg Capacity<br>1 Mg Accuracy |
| 4.4 | Weights: | 2 sets (1 gram to 1 kilogram)<br>Calibration traceable to NBS |

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4.5 Blending manifold with pressure gauges to cover 0-30, 0-300, and 0-2000 PSIA and (1) vacuum gauge 0-5 PSIA

4.6 Vacuum Pump: 150 liter/min maximum capacity
Ultimate pressure 1 millitorr Hg absolute.

4.7 Pure Gases

- Zero grade Air:
  - 220-300 cubic feet
  - 2000-2600 P.S.I.G.
  - Max. THC 0.1 PPMC
  - $O_2$ 19-23% Analyzed
- Zero grade Nitrogen:
  - 220-300 cubic feet
  - 2200-2600 P.S.I.G.
  - Max. THC 0.1 PPMC
- $O_2$ free nitrogen for NO blend
- Propane - Instrument Grade 99.5% minimum
- Carbon Dioxide - Coleman - 99.8% minimum
- Carbon Monoxide - Ultra high purity - 99.8%
  THC 1 PPMC
- Nitric Oxide, C.P. Grade, 99.0% Min.

## 5.0 PRECAUTIONS

5.1 Gas blending should be attempted only by qualified personnel familiar with the chemistry of gases and blending equipment operations. Equipment damage, serious injury, or loss of life could occur from deviations from prescribed practices.

5.2 Personnel should be familiar with safe handling of compressed gases

5.3 Avoid sudden surges of gases when blending or transferring. Always "Bleed" gas slowly from one cylinder to another in order to minimize temperature changes.

5.4 Special precautions should be taken when blending combustible gases such as propane and CO with air. Only very low concentrations should be attempted i.e., less than 1000 PPM.

5.5 Attach only the diluent being used to the blending manifold (air or nitrogen).

5.6 All traces of combustible material such as oil, grease, and solvents shall be removed from the gauges, fittings, valves and tubing contained in the blending manifold. All manifold parts should be specified, "cleaned for oxygen service," when ordered.

5.7 Cylinder valves should be inserted with teflon lubricant only.

5.8 Never drop cylinder or weights onto balance pans or release quickly.

## 6.0 VISUAL INSPECTION

6.1 Cylinders:

- Check for valve or cylinder damage, especially the threads on the valve.
- Check the cylinder for dirt or other contamination

6.2 Blending Manifold:

- Check all tubing and the cylinder connections for loose or damaged fittings.
- Check gauges for proper atmospheric reading.

6.3 Balance:

- Check for any visual damage.
- Check weights for damage or contamination.

## 7.0 PREPARATION

7.1 Weights:

Remove all weights from the balance pans and case, dust them carefully and wipe any smears from the weights with a lint free cloth. Do not touch with hands.

The weights should be kept in their box when not in use and should only be handled with the transfer tool provided.

7.2 Balance:

Turn the vernier chain mechanism to zero and release the pans of the balance. Check the action of the pan arrest pads and adjust if necessary to achieve smooth operation. When the pans are stable, the indicator should read null. If it does not, adjust the zero knob to bring the needle to the null position. Arrest and release the pans several times to assure that the balance stabilizes in the null position. The balance point for the loaded pans should be within ±10 mg.

The weights are now ready to be cross checked on the balance to assure accurate determination under loaded conditions. Place the weights in the center of the pans as indicated below and note any deviations.

| Left Pan | Right Pan |
|---|---|
| 0 | 0 |
| 1 | Vernier |
| 1, 2 | 3 |
| 2, 3 | 5 |
| 2, 3, 5 | 10 |
| 2, 3, 5, 10 | 20 |
| 10, 20 | 30 |
| 20, 30, 2 | 50, 1, Vernier |
| 20, 30, 50 | 100 |
| 0 | 0 |
| 20, 30, 50, 100 | 200 |
| 100, 200 | 300 |
| 200, 300 | 500 |
| 200, 300, 500 | 1000 |
| 0 | 0 |

7.3 Cylinders:

New cylinders or cylinders which have been recently revalved should be checked for leaks by pressurizing to 1800 PSIG with nitrogen. Some leaks are not apparent until the cylinder has reached its maximum pressu[illegible] distortion. Check for leaks with "Snoop" or other device which will not leave a residue on the cylinder. Check valve stem, relief device and cylinder threads. Note results in cylinder log. Correct leaks if possible. If valve is leaking at the cylinder threads, the valve must be removed and reinserted. Do not attempt to tighten valve.

Cylinders which have previously been used for mixtures should be flushed with the diluent (air or nitrogen) as follows:

- Vent cylinder contents slowly in the hood being certain the hood blower is operating.
- Evacuate to 1.0 PSIA.
- Fill to 15 PSIG (30 PSIA) with diluent to be used.
- Vent the contents and evacuate. Repeat this purge to final evacuation 0.2 PSIA.
- Confirm that cylinder pressure is less than 0.2 PSIA.
- Close cylinder valve firmly and proceed to the blending procedure.

7.4 Blending Manifold:

With all vents closed on the manifold, pressurize all gauges to 25 PSIA and close off the manifold. Check all gauges for correlation and observe the readings for indicating leakage. Find and correct any leakage. This is especially important in preparation of NO blends. Small oxygen leaks will oxidize the NO to $NO_2$ and this can occur at manifold pressures above atmospheric. Leakage of the NO gas should be avoided because of its toxicity and transfer should be performed in a hood or well ventilated area.

## 8.0 TEST PROCEDURE

The preparation of gravimetric gas mixtures basically involves two procedures, blending and weighing. Blends are made according to the information contained on Form No. 101-01. This form must accompany the work order and be completed by the requestor. Refer to Reference 3.1 for calculation procedures. Test data is entered on Form No. 101-02.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| | Parent Blend Made From Pure Component | |
| 101 | Evacuate and purge with diluent ($N_2$ or Air, whichever will be used in the mixture) twice and then evacuate the cylinder to 0.2 PSIA. Close the cylinder valve and remove the vacuum line. | None |
| 102 | Wipe cylinder to remove the dust and place on the left pan of the balance. | Record cylinder number |
| 103 | Place a similar type cylinder on the right pan to compensate for buoyancy. This same cylinder must be used for all subsequent weight determinations. Record cylinder number in blending log book. | Log Book Entry |
| 104 | Add weights to right pan until null indicator shows a deflection. This will indicate that the null is within 1 gram of the weight. NOTE: If the blending cylinder should weigh less than the tare cylinder a weight must be added to the left pan. Do not remove this weight until all weighings have been completed. | None |
| 105 | Close balance door and obtain final null with vernier chain. Record sum of wts. on right balance and null vernier indicator weight. Secure and release pans to assure zero null. | Cylinder Weight Grams |
| 106 | Attach the cylinder to the minor component regulators. (This line should be equipped with a flow control valve.) Purge the line with the minor component up to the empty cylinder valve. | |

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 107 | Set the regulator on the minor component to the pressure indicated under column shown $P_1$ PSIG on form 101-01. If pressure is less than atmospheric the blending manifold must be used and cylinder is filled using the pressure indicated under PSIA. | |
| 108 | With the flow control valve closed, open the cylinder valve. Bleed in the desired amount of pure component. If above atmospheric allow the cylinder to attain equilibrium with the regulated pressure. | |
| 109 | Close the cylinder valve, and shut off minor component. NOTE. To achieve 0.1% accuracy always add at least 5 grams of minor components. Reweigh the cylinder as in Sequence 102-105. | Weight after adding minor component |
| 110 | The cylinder is now ready for the addition of diluent. The cylinder is attached to the gauge manifold and the lines are purged with diluent up to the CGA fitting. When the 0-2000 PSIA gauge reaches a pressure higher than that of the cylinder (200 PSI), open the cylinder valve and fill it by regulating the diluent in 100 PSIA increment. Close the cylinder valve when the pressure gauge needle moves past the desired final pressure. The final pressure should be approximately 3% final pressure higher than desired to makeup for the pressure loss due to the cylinder cooling. | None |
| 111 | Shut off the diluent source and bleed the manifold before disconnecting the cylinder. Reweigh the cylinder as in sequence 102-105 after the cylinder has reached ambient temperature. | Weight after adding Major Comp.Grams |
| 112 | Record the three weights and submit the data for computation of mass ratio, concentration, and final pressure. | Initial<br>Minor<br>Final |

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 113 | The parent blend should be mixed thermally for 1/2 hour by directing a heat lamp from a distance of 18-24 inches at the bottom of the cylinder which has been tilted $45^\circ$ with the horizontal. | |
| 114 | If a dilution of the parent mixture is to be made, the same procedure is used except that the parent blend can be added to the empty cylinder by using a well purged regulator to obtain the approximate pressure needed to achieve the final concentration desired. | |

## 9.0 DATA INPUT

Form 101-02 requires the following:

Blending Date
Components
Operators Initials
Cylinder Numbers
Cylinder weights (3) Initial, Minor, Final
Comments

## 10.0 DATA ANALYSIS

10.1 Submit data for analysis by "CYLBLEND" computer program.

## 11.0 DATA OUTPUT

11.1 Computer print out showing calculated mass ratio concentration. Forward with complete job request to requestor.

11.2 Compare specified value with calculated value. Check final cylinder pressure.

11.3 Check computer entries against original data form.

11.4 If cylinder was previously used, check to see that it has been deleted from the inventory list.

## 12.0 ACCEPTANCE CRITERIA

12.1 Calculated values should agree with specified within ±5%. If not determine cause and if final concentration is acceptable, correct and report the errors or failures.

## 13.0 QUALITY PROVISIONS

13.1 See Section 7.2 balance check.

13.2 NBS certified weights are used to check the working weights at six month intervals.

13.3 Gases used for blending are checked for purity when received from supplier.

# GRAVIMETRIC GAS BLENDS

## SPECIFICATION DATA

| NOMINAL CONCENTRATION | COMP. MINOR / MAJOR | MINOR BLEND REQ'D. | PRESS. $P_1$ PSIG | PRESS. $P_1$ PSIA | APPROX. $M_1$ GRAMS | | PRESS. $P_2$ PSIA | APPROX. $M_2$ GRAMS | MARISON CYL. SERIAL No. USED |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
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FORM 101-01

## GRAVIMETRIC GAS BLENDS
## INPUT DATA SHEET

| BLENDING DATE | COMPONENTS MINOR | COMPONENTS MAJOR | BLENDERS INITIALS |
|---|---|---|---|
| - - |  |  |  |

5 10 15 20

**COMPONENT SYMBOLS**

| | | | |
|---|---|---|---|
| MINORS | $C_3H_8$ | - PROPANE | (99.5%.MIN.) |
| | CO | - CARBON MONOXIDE | " |
| | $CO_2$ | - CARBON DIOXIDE | " |
| | NO | - NITRIC OXIDE | " |
| | $CH_4$ | - METHANE | " |
| MAJORS | AIR | - ZERO GRADE AIR | |
| | $N_2$ | - ULTRA PURE NITROGEN | |

| BLEND NO. | CYLINDER NUMBERS NEW BLEND 4 | CYLINDER NUMBERS PARENT BLEND 12 | CYLINDER WEIGHTS (GRAMS) INITIAL (EMPTY) 21 | CYLINDER WEIGHTS (GRAMS) AFTER ADDING MINOR 29 | CYLINDER WEIGHTS (GRAMS) AFTER ADDING MAJOR 37 | 44 COMMENTS: |
|---|---|---|---|---|---|---|
| 1 | - | - | . | . | . | |
| 2 | - | - | . | . | . | |
| 3 | - | - | . | . | . | |
| 4 | - | - | . | . | . | |
| 5 | - | - | . | . | . | |
| 6 | - | - | . | . | . | |
| 7 | - | - | . | . | . | |
| 8 | - | - | . | . | . | |

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

NOTES: TWO SPECIAL PARENT CYLINDER NUMBERS ARE RECOGNIZED.
" -PURE " INDICATES A PARENT BLEND HAS BEEN MADE FROM PURE COMPONENTS.
" -VENT " INDICATES THAT THE CYLINDER REFERENCED HAS BEEN VENTED AND IS TO BE DELETED FROM THE FILE OF CYLINDERS.

MTS COMMAND: $ RUN SAQF: CYLBLEND. [SCARDS = *SOURCE*] [SPRINT = *SINK*]
DATA SETS MUST BE SEPARATED BY A SINGLE $ ENDFILE CARD.
TOTAL RUN TERMINATES ON TWO $ ENDFILE CARDS.

Form 101-02

## EPA STANDARDS INVENTORY

## GRAVIMETRIC GAS BLENDS

### Propane in Air

3 ppm *
5 ppm
10 ppm *
15 ppm
25 ppm
50 ppm *
75 ppm
100 ppm *
150 ppm
200 ppm
275 ppm
350 ppm
500 ppm *
1000 ppm

### Methane in Air

3 ppm
10 ppm
25 ppm
50 ppm
75 ppm
100 ppm
300 ppm
1000 ppm
20000 ppm P/$N_2$

### Propane in $N_2$

100 ppm
200 ppm
400 ppm
600 ppm
800 ppm
1000 ppm
2000 ppm
3000 ppm
4000 ppm
6000 ppm
8000 ppm
10000 ppm P
15000 ppm
20000 ppm

### CO in $N_2$

5 ppm
10 ppm
25 ppm
50 ppm*
100 ppm*
150 ppm
200 ppm
250 ppm
500 ppm*
750 ppm
1000 ppm*
1250 ppm
1500 ppm
2000 ppm
2500 ppm
3000 ppm
4000 ppm
0.5%
1.0%
1.5% P
2.5%
5.0%
7.5%
10.0%

### $CO_2$ in $N_2$

0.2%
0.4%
0.6%
0.8%
1.0%*
1.5%
2.0%
2.5%
3.0%
4.0%
5.0%
7.0%
9.0%
11.0%
13.0%
15.0%*

### NO in $N_2$

25 ppm
50 ppm *
75 ppm
100 ppm *
250 ppm *
500 ppm *
750 ppm
1000 ppm *
1500 ppm
2000 ppm
5000 ppm
20000 ppm

NOTE: The concentrations shown here are the nominal values (+0,-10%) which are to be generated, inventoried, and maintained as gravimetric standards.

SYMBOLS: P = Parent Blend
* = NBS Standard

TP-101
Attachment No. 2

```
           *** GRAVIMETRIC GAS BLEND ANALYSIS ***

              DATE: 05-11-74        MINOR COMPONENT: CO
           BLENDER: JK              MAJOR COMPONENT: N2

MEASURED DATA:

                   PARENT             MEASURED CYLINDER WEIGHTS:
CYLINDER NO.   CYLINDER NO.     EMPTY      AFTER MINOR   AFTER MAJOR
************   ************  ***********  ***********  ***********
                                (GRAMS)      (GRAMS)      (GRAMS)
  G-11865          -VENT
  G-11832          -VENT
  G-11832          -PURE        79.095       85.832      430.388

CALCULATED DATA:

                 MINOR            MAJOR        MASS        BLEND        CYL.
CYLINDER NO.     COMP.            COMP.        RATIO       CONC.       PRESS.
************ *********        *********    *********   *********    ********
              (GRAMS CO  )  (GRAMS N2  )                 (PPM)       (PSIA)
  G-11865
  G-11832
  G-11832        6.737         344.556    0.0191777   19181.750      1230.

COMMENTS DATA:

CYLINDER NO.
  **********
  G-11865   USED FOR CH4 / C3H8 BLEND
             ***CYLINDER NOT FOUND.
  G-11832   ERROR IN PREVIOUS MASSES
  G-11832   99.5% PURE SCOTT B-354

                    PROCESSED:  08:45.00  MAY 14, 1974
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*** GRAVIMETRIC GAS BLEND ANALYSIS ***

              DATE: 05-11-74        MINOR COMPONENT: CO
           BLENDER:  JK             MAJOR COMPONENT: N2

MEASURED DATA:

                   PARENT               MEASURED CYLINDER WEIGHTS:
CYLINDER NO.   CYLINDER NO.      EMPTY        AFTER MINOR    AFTER MAJOR
************   ************   ***********    ***********    ***********
                                 (GRAMS)        (GRAMS)        (GRAMS)
   F-01363         -PURE         111.534        115.804        543.439
   F-01364       G-11864         145.703        215.915        512.363
   F-01366       G-11864         127.413        196.903        402.777
   F-01367       G-11832         117.401        196.591        402.762
   F-01369         -PURE          10.725         20.449        388.788
   F-01370         -PURE          74.364         93.592        458.242
   F-01372         -PURE          63.287         90.777        444.509
   F-01374         -PURE          98.023        136.893        474.774
               ***MORE THAN 8 DATA CARDS.

CALCULATED DATA:

                 MINOR            MAJOR          MASS           BLEND          CYL.
CYLINDER NO.     COMP.            COMP.          RATIO          CONC.          PRESS.
************   *********        *********      *********      *********      ********
              (GRAMS CO  )     (GRAMS N2  )                     (PPM)          (PSIA)
   F-01363        4.270          427.635      0.0098864       9888.500        1512.
   F-01364       70.212          296.448      0.0031751       3175.768        1283.
   F-01366       69.490          205.874      0.0041843       4185.219         964.
   F-01367       79.190          206.171      0.0053221       5323.184         999.
   F-01369        9.724          368.339      0.0257206      25725.941        1323.
   F-01370       19.228          364.650      0.0500889      50099.020        1344.
   F-01372       27.490          353.732      0.0721102      72124.563        1334.
   F-01374       38.870          337.881      0.1031716     103191.375        1319.

COMMENTS DATA:

CYLINDER NO.
************
   F-01363    SCOTT 8582
   F-01364
   F-01366
   F-01367
   F-01369    SCOTT 8582
   F-01370    SCOTT 8582
   F-01372    SCOTT 8582
   F-01374    SCOTT 8582

                    PROCESSED:  08:45.00  MAY 14, 1974
```

```
CYLINDER MASS RATIO MAJOR DILUTANT CONCENTRATION PRESSURE BLENDING DATE
******** ********** ***** ******** ************* ******** *************

F-01374   1.0317E-01 .CO    N2      103191.375     1319.   05-11-74
F-01372   7.2110E-02  CO    N2       72124.563     1334.   05-11-74
F-01370   5.0089E-02  CO    N2       50099.020     1344.   05-11-74
F-01369   2.5721E-02  CO    N2       25725.941     1323.   05-11-74
G-11832   1.9178E-02  CO    N2       19181.750     1230.   05-11-74
G-11842   1.6698E-02  CO    N2       16701.809     1494.   12-10-73
G-11871   1.6635E-02  CO    N2       16638.902     1505.   01-16-74
G-11864   1.6581E-02  CO    N2       16584.137     1534.   01-16-74
H-89471   1.6204E-02  CO    N2       16207.551     1526.   01-16-74
F-01363   9.8864E-03  CO    N2        9888.500     1512.   05-11-74
F-01367   5.3221E-03  CO    N2        5323.184      999.   05-11-74
F-01366   4.1843E-03  CO    N2        4185.219      964.   05-11-74
F-01364   3.1751E-03  CO    N2        3175.788     1283.   05-11-74
H-89456   2.8147E-03  CO    N2        2815.347     1595.   08-25-73
G-11841   2.4125E-03  CO    N2        2413.045     1547.   04-13-73
G-11833   1.8365E-03  CO    N2        1836.925     1512.   04-13-73
G-11831   1.4102E-03  CO    N2        1410.503     1565.   04-13-73
G-11849   1.2273E-03  CO    N2        1227.580     1516.   04-13-73
G-11829   9.9960E-04  CO    N2         999.817     1424.   04-13-73
G-11863   9.0102E-04  CO    N2         901.215     1443.   11-01-73
G-11856   7.0533E-04  CO    N2         705.482     1538.   04-13-73
H-89474   5.2208E-04  CO    N2         522.192     1447.   11-01-73
G-11828   4.8207E-04  CO    N2         482.176     1365.   11-05-73
G-11873   2.5628E-04  CO    N2         256.333     1526.   03-02-73
H-89475   1.9196E-04  CO    N2         192.006     1399.   08-25-73
G-11848   1.2663E-04  CO    N2         126.660     1475.   08-25-73
G-11838   1.0399E-04  CO    N2         104.014     1388.   11-01-73
G-11840   9.0859E-05  CO    N2          90.879     1328.   08-25-73
G-11825   5.0301E-05  CO    N2          50.312     1365.   11-01-73
H-89469   2.9838E-05  CO    N2          29.844     1023.   08-25-73
H-89460   9.1836E-06  CO    N2           9.186     1054.   08-25-73

G-11845   2.2610E-01  CO2   N2          15.682     1799.   09-25-73
G-11839   2.0178E-01  CO2   N2          13.662     1524.   09-25-73
G-11854   1.7216E-01  CO2   N2          11.691     1460.   09-25-73
G-11868   1.2925E-01  CO2   N2           8.635     1590.   09-25-73
G-11850   1.0236E-01  CO2   N2           6.768     1567.   09-25-73
G-11862   7.6649E-02  CO2   N2           5.019     1566.   09-25-73
H-89462   5.7714E-02  CO2   N2           3.753     1400.   09-25-73
G-11853   4.7014E-02  CO2   N2           3.045     1480.   09-25-73
G-11866   3.6004E-02  CO2   N2           2.453     1537.   09-25-73
G-11847   3.0567E-02  CO2   N2           1.968     1539.   09-25-73
G-11858   2.6188E-02  CO2   N2           1.683     1490.   09-25-73
H-89464   1.6787E-02  CO2   N2           1.075     1279.   09-25-73
H-89476   1.6008E-02  CO2   N2           1.025     1120.   02-22-74
G-11870   1.3044E-02  CO2   N2           0.834     1076.   02-22-74
G-11867   9.8799E-03  CO2   N2           0.631     1092.   02-21-74
H-89465   9.7052E-03  CO2   N2           0.620     1584.   09-25-73
G-11851   6.6281E-03  CO2   N2           0.423     1118.   02-21-74
G-11843   3.6106E-03  CO2   N2           0.230     1543.   02-21-74

G-11872   1.4404E-02  C3H8  AIR       9472.020      748.   03-02-73
G-11844   1.2420E-02  C3H8  AIR       8161.988     1435.   03-02-73
G-11837   1.8923E-03  C3H8  AIR       1238.997     1035.   03-02-73
H-89473   1.8520E-03  C3H8  AIR       1212.553     1639.   08-28-73
G-11846   7.0924E-04  C3H8  AIR        464.185     1023.   10-01-73
G-11860   6.5849E-04  C3H8  AIR        430.960     1247.   03-02-73
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G-11861    6.2204E-04  C3H8  AIR        407.102     770.   03-02-73
G-11836    5.0684E-04  C3H8  AIR        331.554    1405.   03-02-73
G-11827    4.1203E-04  C3H8  AIR        267.635    1690.   03-02-73
G-11869    2.8330E-04  C3H8  AIR        185.388    1604.   03-02-73
H-89470    1.6471E-04  C3H8  AIR        107.778     740.   03-02-73
H-89459    1.5253E-04  C3H8  AIR         99.808    1229.   08-29-73
H-89466    1.1360E-04  C3H8  AIR         74.332    1014.   11-29-73
H-89457    9.4779E-05  C3H8  AIR         62.018    1015.   03-02-73
H-89480    6.7034E-05  C3H8  AIR         43.863    1068.   10-01-73
G-11835    3.7174E-05  C3H8  AIR         24.324    1011.   10-01-73
G-11857    2.2940E-05  C3H8  AIR         15.010    1010.   11-29-73
H-89472    1.3414E-05  C3H8  AIR          8.777    1042.   10-01-73
G-11852    9.5187E-06  C3H8  AIR          6.228    1432.   10-01-73
G-11826    4.6832E-06  C3H8  AIR          3.064    1486.   10-01-73

H-89458    1.6650E-04  C3H8  N2         105.791    1194.   08-28-73

                    PROCESSED:  08:45.05  MAY 14, 1974
```

| | | |
|---|---|---|
| **EPA TEST PROCEDURE** | **Number**<br>TP-102 | **Page** 1 **of** 9 |

**SUBJECT**

Calibration of Gas Mixtures (Gas Analysis)

| | |
|---|---|
| **Reference**<br>FR 85.075-23(a) (4) | **Data Form No.**<br>102-01 |
| **Responsible Organization**<br>Correlation & Maintenance | **Computer Program**<br>CYLANAL |
| **Test Witness** /Review<br>Requestor, Quality Assurance | **Performance Interval**<br>See Below |
| **Type of Test Report**<br>Computer Print Out | **Supersedes**<br>New |
| **Report Distribution**<br>Purchasing, Correlation & Maintenance | **Superseded by** |

**REMARKS/COMMENTS**

1. Analysis of calibration gases are performed when the gases are received from a vendor, when requested by a contractor or manufacturer for correlation and traceability reasons and when an in-house gas is suspect for any reason.

**ORIGINAL RELEASE APPROVALS**

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt. | Quality Assurance | | |
| Administration | Procurement | | |
| Lab. Branch | Supervisor | | |
| Lab. Branch | Support Oper. Supv. | | |
| | | | |

**REVISIONS**

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

## 1.0 PURPOSE

To determine gas mixture concentrations by comparing them to known standards used as calibration gases, working gases and, in some cases, zero gases for the EPA laboratory, contractors, manufacturers.

## 2.0 TEST ARTICLE DESCRIPTION

A gas blend or mixture blend of two or more gases under pressure in a cylinder or other suitable container.

## 3.0 REFERENCES

3.1 Analytical instrument manuals

3.2 "Handbook of Compressed Gases", Compressed Gas Associaton, Inc., N.Y., N.Y., Reinhold Publishing Corp., Inc., 1966.

## 4.0 REQUIRED EQUIPMENT

4.1 Primary gas standards, verified, gravimetric, or NBS cylinders. Verified standards must be traceable to the EPA gravimetric standards by not more than one generation. Zero gas, air or nitrogen as required.

4.2 Analytical instruments with the following minimum specifications:

| | |
|---|---|
| Sensitivity: | Full scale for the concentration to be determined. |
| Reproducibility: | 1% of full scale, for successive identical samples. |
| Stability: | Electronic stability of ±1% per 24 hours. |
| Response: | 90% of scale in 0.5 seconds. |
| Dectector Type: | CO, $CO_2$ - NDIR: HC - FID, NO - CHEMI. |

4.3 Sample handling system, manual or automatic, designed for a minimum hook up of 2 span gases, one zero gas and the gas to be analyzed. The system need not be equipped with a sample pump unless required but should have line filters, flow meters and pressure gauges. The materials of construction of the equipment prior to the instrument sample inlet should be of teflon, stainless steel and viton. Use best judgment for the instrument exhaust plumbing and equipment.

4.4 Pressure regulators, dual stage, outlet pressure to be regulated between 0-80 PSIG, inlet pressure rated at 4000 PSI with a gauge 0-3000 PSI. The regulator should be equipped with a purge port and safety relief port. Regulators used for nitrogen oxide or any other corrosive gas should be of stainless steel construction only, the other gases require brass with teflon or viton seals.

NOTE: Some regulators use a Buna N or other rubber type material for construction of the diaphragm. These should never be used for gas analysis for hydrocarbon or the zero gases.

4.5 Recorder to match the output of the analytical instrument.

4.6 Digital volt meter with the capability of reading the output to at least one significant figure (preferably two).

## 5.0 PRECAUTIONS

5.1 Check work order for adequate information of the sample to be analyzed such as I.D. number, nominal concentration, sample pressure, components to be analyzed and type of analysis.

5.2 Check the sample container for proper identification. Check high pressure cylinder for date of last pressure test. If longer than 5 years the cylinder should be returned to the vendor.

5.3 Be sure that the analytical system and the regulator purge lines are properly vented to a hood or other air removal system.

5.4 Excessively high flow rates or long analysis times should be avoided as this could use a large amount of span or sample gas.

## 6.0 VISUAL INSPECTION

6.1 Examine sample container for damage.

6.2 Check the container number against the work order for agreement.

6.3 Check the analytical system for loose lines, dirty filters or missing parts.

## 7.0 TEST ARTICLE PREPARATION

7.1 Attach a suitable pressure regulation device to the sample container.

7.2 Secure the container and check all fittings for leaks using liquid detector such as "Snoop".

7.3 Purge regulator and sample line through the venting system.

7.4 Turn on instrument and allow to reach temperature and electronic stability. Time will depend on instruments and previous history of use.

7.5 Select two span gases, one should indicate a value above the maximum concentration of the sample being evaluated and one below the minimal concentration of the sample. Neither span gas should exhibit values closer than ±10 percent of full scale of the sample concentration.

## 8.0 TEST PROCEDURE

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Zero instrument using the same flow, pressure and range as will be used for the span and sample gases.<br>NOTE: Pressure should be measured closely as possible to the detector inlet. | 0 ± 0.1 Reading |
| 102 | Span instrument using the highest concentration standard at 95% of scale | 95.0 ± 0.2 |
| 103 | Switch to zero gas. If instrument does not repeat zero, adjust and repeat 102. | 0 ± 0.1 |
| 104 | Repeat zero and span. | |
| 105 | Introduce second span gas and record deflection Repeat twice. | Average Deflection |
| 106 | Introduce sample gas at same flow and pressure as zero and span. Repeat twice. Reading should agree within ±0.2% of full scale. | |
| 107 | Introduce zero gas and both span gases. Previous readings should agree within 0.2% of full scale. If not repeat procedure. | None |
| 108 | Record data on form #102-01. | |
| 109 | If the sample gas deflection does not fall between the two points the gas may not be within the required tolerances. Select another set of standards, repeat #106 and 107 and document results. | |

## 9.0 DATA INPUT

Form No. 102-01 requires the following information:

- Data
- Analyzer train no.
- Mixture components
- Analyzer vendor
- Sample flow rate and pressure
- FID pressure, air & fuel
- Operators initials
- Cylinder number analyzed
- Nominal concentration
- Analyzer setup data
  Low end concentration - meter deflection
  High end concentration - meter deflection
  Meter deflection of gas analyzed
- Comments: Reference for standard gases used and zero gases.

## 10.0 DATA ANALYSIS

10.1 Determine if low point and high point concentrations are adequate to determine the sample concentration. Reliability of the data is a function of the separation of the two standards and the closeness to one of the two standards.

10.2 Determine that the deflection for the sample gas is between (or close to) the deflections for the bracketing standards.

10.3 Confirm that operating parameters are within normal or recommended specifications.

10.4 Check the calculated concentrations for apparent agreement with deflection.

10.5 Note comments for possible conflicts or indication of problems.

## 11.0 DATA OUTPUT

11.2 Data entered into cylinder inventory file.

11.3 Data sent to person or company by division representative requesting the analysis.

## 12.0 ACCEPTANCE CRITERIA

12.1 Instrument technician must determine that repetition of the zero gas is within ±0.1 deflection and that the span is within ±0.2 deflections.

12.2 Deflection for the sample gas must be between the deflections for the two standards.

12.3 The sample gas concentration determined must meet the blending specifications requested from vendor.

## 13.0 QUALITY PROVISIONS

13.1 Repetition of span and zero readings

13.2 Repetition of sample readings

13.3 Repetition of span and zero after sample analysis

13.4 Data verification (10.0)

13.5 Acceptance criteria (12.0)

# GAS BLEND ANALYSIS DATA

| DATE | ANALYZER TRAIN NO. | MIXTURE COMP. GAS | MIXTURE COMP. BAL | ANALYZER VENDOR | SAMPLE FLOW RATE SCFH | SAMPLE FLOW RATE "$H_2O$ | FID PRESSURE AIR | FID PRESSURE FUEL | OPER. INIT. |
|---|---|---|---|---|---|---|---|---|---|
| - - | | | | | . | . | . | . | |

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

| CYLINDER NO. ANALYZED | NOMINAL CONCENTRATION (3) | ANALYZER SETUP DATA (NOTE) LOW END CONC. (1) | METER DEFL. | HIGH END CONC. (2) | METER DEFL. | (3) METER DEFL. | COMMENTS: |
|---|---|---|---|---|---|---|---|
| | . | . | . | . | . | . | |
| | . | . | . | . | . | . | |
| | . | . | . | . | . | . | |
| | . | . | . | . | . | . | |
| | . | . | . | . | . | . | |
| | . | . | . | . | . | . | |
| | . | . | . | . | . | . | |
| | . | . | . | . | . | . | |
| | . | . | . | . | . | . | |

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

NOTE: Use verified, gravimetric, or NBS cylinders for analyzer setup values.

Form 102-01

# Section 200

# CALIBRATION

| | | |
|---|---|---|
| **EPA TEST PROCEDURE** | **Number**<br>TP-201 | **Page** 1 **of** 7 |

| | |
|---|---|
| **SUBJECT**<br>CVS CALIBRATION PROCEDURE FOR POSITIVE DISPLACEMENT PUMP | |
| **Reference** Federal Register, Vol. 38, No. 124, June 28, 1973, Appendix III, 85.075-20 | **Data Form No.**<br>201-01 |
| **Responsible Organization**<br>Correlation and Maintenance | **Computer Program**<br>SAQF:CALIBCVS |
| **Test Witness**<br>Corr. and Maint. Technician/Quality Assurance | **Performance Interval**<br>See Remarks |
| **Type of Test Report**<br>Computer Print-Out | **Supersedes**<br>New |
| **Report Distribution**<br>Quality Assurance, Test Operations, Correlation & Maint. | **Superseded by** |

**REMARKS/COMMENTS**

1.0 CVS must be calibrated every 0, 50, 100, 200, 400, 800, etc., hours of use or after major breakdown, cleaning and modification. The CVS will also be calibrated as required to meet specific contract requirements.

**ORIGINAL RELEASE APPROVALS**

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt. | Quality Assurance | | |
| Lab. Branch | Test Oper. Chief | | |
| Lab. Branch | Facilities Support Chief | | |
| | | | |
| | | | |

**REVISIONS**

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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## 1.0 PURPOSE

To measure the various parameters which must be assessed to establish the flow rate of the constant volume sampler pump. All the parameters related to the pump are simultaneously measured with the parameters related to a flowmeter which is connected in series with the pump. The calculated flow rate ($ft^3$/rev. @ pump inlet absolute pressure and temperature) can then be plotted versus a function that is the value of specific combinations of pump parameters.

## 2.0 TEST ARTICLE DESCRIPTION

A constant volume sampler which meets requirements stated in Federal Register 85.075-20.

## 3.0 REFERENCES

3.1 Federal Register, Vol. 38, No. 124, June 28, 1973, 85.075-20,- Appendix III

3.2 EPA, Ann Arbor, Preventive Maintenance Guidelines - Section I

## 4.0 REQUIRED EQUIPMENT

The following equipment is required to perform the CVS calibration:

4.1 LFE - Laminar Flow Element (calibrated by manufacturer)

4.2 Micromanometer (see 7.3 for calibration check)

4.3 Thermometer

4.4 Timing mechanism

4.5 U-tube Manometers

4.6 Temperature Indicator with "J-Type" thermocouples (see procedure #TP205 for calibration)

4.7 A variable flow restrictor with appropriate piping to connect CVS pump and LFE.

## 5.0 PRECAUTIONS

5.1 Special care should be taken in the initial set-up of the calibration equipment. Leaks in the system or faulty calibration equipment will void the calibration.

5.2 The variable flow restrictor valve should be placed in the "open position" at the start of the calibration. CAUTION: never completely close the valve while the pump is in operation; the motor may be damaged.

5.3 Temperature stability during the calibration is absolutely necessary. Air handling equipment must be shut off to avoid the normal 4°F oscillations. Gradual temperature increases (2°F are acceptable as long as they occur over a period of several minutes.

5.4 Thermocouples must be checked for accuracy using a laboratory grade thermometer.

## 6.0 VISUAL INSPECTION

6.1 Check LFE to CVS pump connections for loose fittings

6.2 Check manometers for level placement.

6.3 Check thermocouple connections for tightness.

## 7.0 TEST ARTICLE PREPARATION

7.1 Connect system as shown in Figure below.

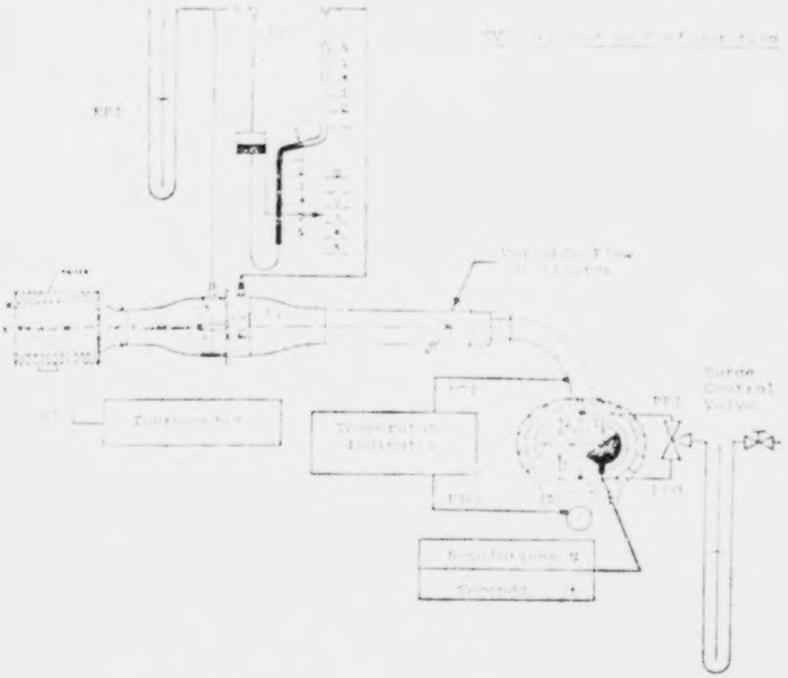
PPI
Variable Flow Restrictor
Surge Control Valve
PPI
PPI
Temperature Indicator
Revolutions #
Seconds

Figure 7-1

7.2 Connect the LFE and variable flow restrictor to the CVS. Carefully seal all connections to eliminate any leakage between the LFE and CVS pump. NOTE: Refer to previous LFE inlet $\Delta$P, a major drop may indicate a leak in connection.

7.3 Position the micromanometer and level the base using the adjustable feet provided. Set the vertical and the vernier scales on zero and check the meniscus to assure that it is between the hairline reference marks. If not, adjust the fluid at the rear of the case until the meniscus is zeroed. Connect the LFE to the micromanometer and U-tube manometer with leaktight flexible tubing. (See Figure 7-1.)

7.4 Attach the thermometer to the filter of the LFE so that the temperature of the air entering the LFE is indicated.

7.5 Check that the zero level of the U-tube manometers and adjust their scales accordingly.

7.6 Check that the CVS timer starts and stops when the counter power button is pushed.

7.7 Connect the thermocouples to the CVS at the pump inlet and outlet as shown in 7.1. The fittings normally used for sampling, temperature, or sample dump connections may be used for thermocouples.

7.8 Start the CVS pump and open the U-tube manometer surge control valve 1/4 turn. Check the fluid column surge; adjust the valve to insure the fluid will not oversurge (most surge control valves have been replaced by a 20 gauge hypodermic capillary fitting.) when switched from vacuum to pressure. NOTE: Two manometers may be used to measure these differentials simultaneously.

7.9 With the CVS pump running (20 minute warmup), adjust the micromanometer to the null position by cranking the vernier down. Operate the revolution counter and timer to insure proper operation.

7.9.1 Check the revolution counter by measuring revolutions of the pump using a strobotac and comparing the total revs. indicated on the counter for a 3-minute period.

## 8.0 TEST PROCEDURES

The following data will be collected and recorded in order to calculate the CVS calibration curve.

| Parameter | Symbol | Units | Tolerance (accuracy of data collected) |
|---|---|---|---|
| Barmetric Pressure (Corrected) | $P_B$ | "Hg | ±.01 "Hg |
| Ambient Temperature | $T_A$ | °F | ±.5 °F |
| Air Temperature into LFE | ETI | °F | ±.1 °F |
| Pressure depression upstream of LFE | EPI | "$H_2O$ | ±.05 "$H_2O$ |
| Pressure drop across LFE meeting matrix | EDP | "$H_2O$ | ±.005 "$H_2O$ |
| Air temperature at CVS pump inlet | PTI | °F | ±.5 °F |
| Pressure depression at CVS pump inlet | PPI | "Fluid | ±.05 "Fluid |
| Specific Gravity of Manometer fluid | Sp.Gr. | "Fluid | ±.05 "Fluid |
| Pressure differential at CVS pump outlet | PPO | "Fluid | ±.05 "Fluid |
| Air temperature at CVS pump outlet | PTO | °F | ±.5 °F |
| Pump revolutions during test period | N | Revs. | ±0 |
| Elapsed time for test period | t | Secs. | ±.05 Secs. |

| | | |
|---|---|---|
| **REVISIONS:** | CVS CALIBRATION PROCEDURES FOR POSITIVE DISPLACEMENT PUMP<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-201<br>**PAGE** 6 **OF** 7 |

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Set variable restrictor valve in the wide open position and run CVS pump for 20 minutes | -0- |
| 102 | Start counter and timer | |
| 103 | Read air temperature at CVS outlet | PTO, °F |
| 104 | Read pressure depression at CVS pump inlet | PPI, "Fluid |
| 105 | Read pressure differential at CVS pump outlet | PPO, "Fluid |
| 106 | Read ambient temperature | $T_A$, °F |
| 107 | Read barometric pressure (corrected) | $P_B$, "Hg |
| 108 | Read air temperature at CVS inlet | PTI, °F |
| 109 | Read pressure depression upstream of LFE | EDP, "$H_2O$ |
| 110 | Read air temperature in LFE | ETI, °F |
| 110A | Read $\Delta P$ across the LFE matrix | EDP, "$H_2O$ |
| 111 | Read pump revolutions for test period | N, Revs. |
| 112 | Record elapsed time for test period | t, secs. |
| 113 | Reset the restrictor valve to a more restricted condition. A change of about 4"$H_2O$ is adequate to yield a minimum of six data points | |
| 114 | Allow system to stabilize for a minimum of 3 minutes | -0- |
| 115 | Repeat steps 102 through 114 until sufficient data points have been established | -0- |
| 116 | Adjust temperature controller and temperature recorder on the CVS to indicate the proper inlet temperature. Disconnect the micromanometer and recheck zero setting | |
| 117 | Disassemble the calibration setup and reconnect all pipes and fittings as used in NORMAL CVS operation. Check sample flow rates and other indicators for normal operation | |

## 9.0 DATA INPUT

9.1 Complete data form 201-01
9.2 Submit data sheet for analysis.

## 10.0 DATA ANALYSIS

10.1 Analyze data using SAQF:CALIBCVS
10.1.1 These are linear fits of $V_o$ vs. $X_o$ and RPM vs $\Delta P$.

## 11.0 DATA OUTPUT

11.1 Printed computer output
11.2 CVS coefficients for storage in Instrument Data File.

## 12.0 ACCEPTANCE CRITERIA

12.1 Verify new curve against previous curve and tracer gas readings previously obtained.

12.2 All $V_o$ measured values must lie within ±0.50% of the calculated $V_o$ values. All RPM measured speeds must be within ±0.25% of the calculated RPM values.

12.3 Check and verify that the $V_o$ vs $X_o$ intercept is approximately 350 $ft^3$/rev and the RPM vs $\Delta P$ intercept is related to the synchronous speed of the blower motor.

## 13.0 QUALITY PROVISIONS

13.1 An excessive shift from old curve to new curve may constitute an invalid test, therefore an investigation of cause should be implemented.

13.2 Corrective action must be implemented if malfunctions are found and the procedure must be repeated.

# CVS CALIBRATION DATA SHEET

|  |  |  |  | ← MANOMETER FLUID → |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CVS UNIT | LAMINAR ELEMENT NO. | CALIBRATION DATE | # POINTS | LAMINAR ELEMENT SP.GR. | UNITS | CVS PUMP SP.GR. | UNITS | EFFECTIVE TEST # | CVS VENDOR | PUMP RANGE (CFM) | CVS ELAPSED HOURS |  |
| – |  | – – |  |  |  |  |  |  |  |  |  |  |

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

| # | AMBIENT BARO ("HG) | AMBIENT T (°F) | LAMINAR FLOW ELEMENT $T_{IN}$ (°F) | LAMINAR FLOW ELEMENT $P_{IN}$ * | LAMINAR FLOW ELEMENT $\Delta P$ * | CVS PUMP $T_{IN}$ (°F) | CVS PUMP $P_{IN}$ * | CVS PUMP $T_{OUT}$ (°F) | CVS PUMP $P_{OUT}$ * | CVS PUMP REV (COUNTS) | CVS PUMP TIME (SECS) |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |  |  |  |  |  |

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

*NOTE: Indicate manometer units and fluid specific gravity on card one.

UNITS: IN = Inches
CM = Centimeters
MM = Millimeters

Form 201-01

```
                              CVS FLOW CALIBRATION

                                  ************
                                  * CVS-09C *
                                  ************

         LAMINAR ELEMENT: Y722918                  CALIBRATION DATE: 07-13-74
             CVS VENDOR: AMI                       EFFECTIVE TEST #:
             PUMP RANGE: 300 CFM                   CVS ELAPSED HOURS: 1080.9

         MANOMETER SPECIFICATIONS:
               LAMINAR ELEMENT: IN. OF   1.00 SPECIFIC GRAVITY FLUID
                      CVS PUMP: IN. OF   1.75 SPECIFIC GRAVITY FLUID

     MEASURED DATA:

      AMBIENT      LAMINAR ELEMENT                          CVS PUMP
     ********** ****************** ****************************************
      BARO    T      T      P     DELTA     T      P      T      P      REV    TIME
                   (IN)   (IN)      P     (IN)   (IN)  (OUT)  (OUT)  COUNTS  (SECS)
     29.21  82.0  83.4   4.85   7.594   80.0  17.70    0.0  19.40   6299.  257.30
     29.21  83.0  83.4   4.75   7.510   81.0  19.30    0.0  19.00   6187.  253.30
     29.21  83.0  83.5   4.65   7.414   81.0  21.30    0.0  18.70   6516.  267.20
     29.21  83.0  83.5   4.55   7.303   81.0  23.35    0.0  18.35   6278.  257.60
     29.21  83.0  83.6   4.50   7.221   80.0  25.10    0.0  18.10   6138.  252.20
     29.21  83.0  83.8   4.45   7.118   80.0  27.40    0.0  17.75   6213.  255.70
     29.20  83.0  84.0   4.35   7.046   80.0  29.00    0.0  17.55   6125.  252.40

     CALCULATED DATA:

                 CF/REV   CF/REV                  SCFM   PUMP    RPM     RPM
        X        ACTUAL    CALC   CALC/ACT               DIFF    ACT     CALC   CALC/ACT
     .000265     0.2902   0.2903   1.0003     376.0    4.78  1466.5  1466.8  1.0001
     .000270     0.2901   0.2898   0.9990     372.0    4.94  1465.5  1465.4  0.9999
     .000276     0.2897   0.2891   0.9981     367.3    5.16  1463.2  1463.6  1.0003
     .000282     0.2886   0.2885   0.9997     362.0    5.38  1462.3  1461.7  0.9996
     .000288     0.2877   0.2879   1.0008     357.9    5.57  1460.3  1460.1  0.9999
     .000295     0.2872   0.2872   0.9997     352.7    5.82  1457.9  1457.9  1.0000
     .000300     0.2870   0.2866   0.9988     348.9    6.00  1456.0  1456.4  1.0003

     EQUATIONS:

                  RPM = (-.848182E 01 * DIFF) + (0.150733E 04)

                  CF/REV = (-.104931E 03 * X) + (0.318100E 00)

     CF/REV = CUBIC FEET PER REVOLUTION @ ABSOLUTE INLET TEMP AND PRESSURE
     X = (1/RPM) * SQRT(DIFF / ABSOLUTE OUTLET PRES )
     DIFF = DIFFERENTIAL PRESSURE ACROSS THE CVS PUMP IN INCHES OF MERCURY

                       PROCESSED:  14:40.27  JUL 15, 1974
```

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best available copy.

**EPA TEST PROCEDURE**

| | | |
|---|---|---|
| **EPA TEST PROCEDURE** | Number<br>TP-202 | Page 1 of 9 |

SUBJECT
DYNAMOMETER CALIBRATION

| | |
|---|---|
| Reference Federal Register, Vol. 38, No. 124, June 28, 1973<br>Appendix II, 85.075-15(d) | Data Form No.<br>202-1 |
| Responsible Organization<br>Correlation and Maintenance | Computer Program<br>DYNAHP |
| Test Witness/Review<br>Corr. & Maint. Technician, Quality Assurance | Performance Interval<br>Monthly |
| Type of Test Report<br>Computer Print-Out | Supersedes<br>New |
| Report Distribution<br>Quality Assurance, Test Operations, Support Services, file | Superseded by |

REMARKS/COMMENTS

NOTE: This procedure is in the revision phase by EPA, Ann Arbor. The final version will reflect new changes.

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Operations | Chief | | |
| Lab Operations | Support Services Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

## 1.0 PURPOSE

The purpose of the dynamometer calibration procedure is to insure that the indicated speed and the indicated absorbed power (torque) are correct and to determine the frictional loss characteristics of the dynamometer.

## 2.0 TEST ARTICLE DESCRIPTION

2.1 A direct drive chassis dynamometer, having the capabilities described in Federal Register 85.075-15.

2.2 Speed and torque (hp @ 50mph) meters and controls

## 3.0 REFERENCES

3.1 Federal Register, Vol. 38, No. 124, June 28, 1973 - Appendix II

3.2 EPA, Ann Arbor, Preventive Maintenance Guidelines, Section III.

3.3 SAE XJ1094 "Constant Volume Sampler System for Exhaust Emission Measurement," Section 3.7

## 4.0 REQUIRED EQUIPMENT

4.1 Test vehicle

4.2 Stroboscopic tachometer or electronic RPM counter (see manufacturer's manual for calibration procedure)

4.3 Adjustable DC power supply, upper value of at least 8 volts DC

4.4 Weight stand, Clayton

4.5 Weights, 35 pounds and 10 pounds

4.6 Tachometer generator assembly, Clayton

4.7 Varian 614A, strip chart recorder (see procedure #204 for calibration procedure)

4.8 Stopwatch or electric timer (±.1 sec.)

## 5.0 PRECAUTIONS

5.1 Inflate the rear tires to 45 psi to protect against blow-outs and to equalize the contact (especially important with front-wheel drive and radials)

5.2 Align vehicle on dynamometer. (Drive vehicle on to the dyno, with vehicle perpendicular to the rolls, insuring that the front wheels are centered to prevent the rear wheels from sliding off the rolls.)

5.3 Operate vehicle cooling fan within 12 inches of vehicle radiator.

5.4 Vent vehicle exhaust.

## 6.0 VISUAL INSPECTION

6.1 Check equipment set-up. (see sec. 7.0 and 8.0 for set-up instructions.

## 7.0 TEST ARTICLE PREPARATION

NOTE: Prior to calibration assure that the dynamometer is warmed up in accordance with procedure #TP-604

### 7.1 Speed Meter Calibration

7.1.1 Adjust mechanical zero of the speed meter with rolls stopped.

7.1.2 Place range switch to "LO" position.

7.1.3 Record dynamometer Serial Number.

7.1.4 Place vehicle on dynamometer and tie it down.

7.1.5 Engage flywheels for 4,000 pounds inertia.

7.1.6 Check index on the end of front roll for visibility.

7.1.7 Precondition the dynamometer by operating vehicle at 30 mph for 15 minutes.

7.1.8 Warm up strobotac and calibrate strobotac according to manufacturer's specifications.

### 7.2 Power Meter Calibration

7.2.1 All calibration steps take place with dynamometer rolls in stationary position.

7.2.2 Disconnect tachometer leads from torque bridge terminals.

7.2.3 Attach variable voltage power supply to the torque bridge terminals.

7.2.4 Adjust meter to zero with power supply off.

7.3 Determination of Actual Power Absorption

7.3.1 Inspect the dynamometer and service according to manufacturer's recommended procedure.

7.3.2 Install tachometer generator on the dynamometer frame. Line up the tach generator pulley with the shaft adaptor pulley on the front roll. Insure that the center to center pulley distance is the same as the factory installed tach generator.

7.3.3 Attach front roll tachometer generator electrical leads to Varian chart recorder.

7.3.4 Drive vehicle on dynamometer and attach vehicle restraint system.

7.3.5 Disengage roll brakes.

7.3.6 Adjust recorder zero.

| REVISIONS: | DYNAMOMETER CALIBRATION<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-202<br>**PAGE** 5 **OF** 9 |
|---|---|---|

## 8.0 TEST PROCEDURE

The dynamometer calibration is actually separated into three separate procedures. Therefore, the steps listed below are listed in three sections. Section I pertains to speed meter calibration; Section II covers power meter calibration and Section III outlines the determination of actual power absorption.

### SECTION I. SPEED METER CALIBRATION

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Operate vehicle at front roll speed of 1,800 rpm Set strobe tach at 1,800 rpm flash rate and aim at the front roll index mark. Adjust vehicle speed to hold the mark steady at 1,800 rpm. | |
| 102 | When the front roll is steady at 1,800 check the speed meter display. ECE-50 with DD-VIF will indicate 46.3 mph if speed meter is calibrated correctly. | |
| 103 | If the meter indicates other than 46.3 mph, adjust the speed meter calibration pot in the readout instrument assembly, until speed meter indicates correct speed. | |
| 104 | Repeat steps 101 through 103. If readings will not repeat within ±0.5 mph without readjustment a malfunction must be reported. Necessary maintenance should be performed before continuing with calibration. | |
| 105 | Reduce roll speed to 90 rpm and hold steady. The speed indicated on the meter should be 23.15 (±0.5) mph. Any nonlinearity will be reported and corrected. (Perform necessary maintenance before continuing procedure.) | |
| 106 | When calibration is complete, attach calibration sticker to the back of speed meter. | |

### SECTION II. POWER METER CALIBRATION (TORQUE)

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 201 | Turn on power supply and adjust voltage to display 46.3 mph on the speed meter. | |

| REVISIONS: | DYNAMOMETER CALIBRATION<br>**TEST PROCEDURE** | PROCEDURE NO. TP-202<br>PAGE 6 OF 9 |
|---|---|---|

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 202 | Install the weight stand (Arbor) on the Torque Arm. Tighten the attaching bolt. | |
| 203 | Level the torque arm by turning ball joints in or out of the load cell. | |
| 204 | Place (one) 35 lb. weight and (one) 10 lb. weight totaling 50 lbs. on the weight stand (Arbor wt. stand = 5 lbs.). Torque/Power meter should show 50 ft. lbs. of torque. If meter does not show proper value, adjust the meter using the Torque Meter Calibration pot. | 50 ft. lbs. |
| 205 | Repeat Step 204 substituting weights: (1) 10 lb. weight = 15 ft. lbs. torque and the weight stand itself 5 lbs = 5 ft. lbs. torque on meter. The nonadjusted torque readings should agree within ±1 ft. lb. of torque. If meter does not agree within limits without readjustment, a malfunction should be reported. | 15 ft. lbs.<br>5 ft. lbs. |
| 206 | After completing the calibration with no malfunctions, a calibration sticker should be placed on the meter. | |

## SECTION III. ACTUAL POWER ABSORPTION CALIBRATION

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 301 | Accelerate vehicle to 60 mph and hold steady. Calibrate the chart recorder at 60 mph full scale. | |
| 302 | Check the calibration of chart at 55, 50, and 45 mph. Insure that 55 and 45 mph points are easily identified. | 55 = __divis.<br>45 = __divis. |
| 303 | Bring the vehicle to a complete stop and re-zero the recorder. | |

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 304 | Measure the recorder chart speed with a stopwatch or other timing mechanism. This should be repeated at least 3 times for an accurate measurement of the distance the paper travels in one (1) minute.<br>NOTE: Alternate method of measuring elapsed time: Direct measurement of time elapsed between 55 mph and 45 mph can be accomplished by starting electronic timer at 55 mph and stopping at 45 mph. This method will eliminate interpolation of chart method. | Chart Speed (inches/mins) |
| 305 | Set dynamometer inertia at 1,500 lbs. (Insure that rolls are stationary.) | -- |
| 306 | Accelerate vehicle to 50 mph and hold steady. Set the Hp (torque) to lowest obtainable value. | Hp |
| 307 | Increase speed to 60 mph and use a winch or alternate means to pull vehicle off the front drive roll. Release accelerator and allow vehicle to decel (caution: insure rear wheels are completely clear of drive roll). | |
| 308 | Measure and record the elapsed time it takes the front roll to slow from 55 mph to 45 mph. | Time secs., IHP |
| 309 | Loosen the winch and allow vehicle's rear wheels to contact the front roll. Match the front roll speed and vehicle speed as closely as possible to prevent tire damage. | -- |
| 310 | Repeat Steps 307-309 so that two measurements are taken at even 500 lb. increments of inertia starting at 1,500 lbs. and ending with 5,500 lbs. | Elapsed Time IHP |
| 311 | Stop vehicle and check recorder zero. | |
| 312 | Operate vehicle at 50 mph and set Hp at 8.0 indicated Hp. | |
| 313 | Repeat Steps 307-309 so that two readings are taken at each inertia setting, at 8.0 indicated Hp. | Elapsed Time |
| 314 | Repeat Step 311. | |

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 315 | At a steady 50 mph reset Hp to 14.0 indicated horsepower. | |
| 316 | Repeat Steps 307-309 in order that two readings are taken at each inertia at 14.0 indicated horsepower. | Elapsed Time |
| 317 | Remove vehicle from dyno and restore all equipment to normal operating conditions. | |

## 9.0 DATA INPUT

9.1 Complete form No. 202-01. Submit the form and recorder charts to the Data Branch for analysis

9.2 Transfer information to data cards for computer input.

## 10.0 DATA ANALYSIS

10.1 If a chart speed of 6 inches/minute or faster, elapsed time measurements for coastdowns are made from the chart. To make this measurement, the distance between the point the trace crosses the 55 mph speed and the point the trace crosses the 45 mph speed is measured to the nearest 0.01 inch. This distance is then divided by the chart speed.

10.2 A manual curve plot of actual power versus indicated absorber power ($P_{Hp}$ vs $P_{ind}$) is made for each inertia setting.

10.3 Final analysis is made by computer program DYNAHP.

## 11.0 DATA OUTPUT

11.1 Computer print-out of inertia weight (1,500 to 5,500 lbs.) and indicated horsepower per Federal Register requirements shown in paragraph 85.075-15(d).

## 12.0 ACCEPTANCE CRITERIA

12.1 New calibration curve should be within ±1/2 horsepower of previous calibration (SAE XJ 1094)

12.2 Compare graph plots of calibration results with the computer output to insure the data is accurate.

## 13.0 QUALITY PROVISIONS

13.1 If any malfunctions are reported for speed meter or torque meters, insure the proper corrective maintenance is performed and a repeat calibration has been accomplished.

13.2 If calibration does not agree with 12.1 above, reject calibration.

13.3 Perform necessary corrective maintenance or action and repeat the calibration.

# DYNAMOMETER CALIBRATION

DYNO NO. | DATE (MO - DY - YR) | DYNAMOMETER INFO:

| CARD NO. | IND HP | INERTIA WT. | TIME; SEC. |
|---|---|---|---|
| 2 | 40 | 1750 | |
| 3 | 40 | 2000 | |
| 4 | 40 | 2500 | |
| 5 | 40 | 3000 | |
| 6 | 40 | 3500 | |
| 7 | 40 | 4000 | |
| 8 | 40 | 4500 | |
| 9 | 40 | 5000 | |
| 10 | 40 | 5500 | |
| 11 | 80 | 1750 | |
| 12 | 80 | 2000 | |
| 13 | 80 | 2500 | |
| 14 | 80 | 3000 | |
| 15 | 80 | 3500 | |
| 16 | 80 | 4000 | |
| 17 | 80 | 4500 | |
| 18 | 80 | 5000 | |
| 19 | 80 | 5500 | |
| 20 | 140 | 1750 | |
| 21 | 140 | 2000 | |
| 22 | 140 | 2500 | |
| 23 | 140 | 3000 | |
| 24 | 140 | 3500 | |
| 25 | 140 | 4000 | |
| 26 | 140 | 4500 | |
| 27 | 140 | 5000 | |
| 28 | 140 | 5500 | |

PROGRAM: DYNAHP

FORM 202-01

TP-202
Attachment No. 1

```
03 02-04-74    18.8 HP 1800 RPM = 46.3 MPH

PROCESSED:  17:05.43  FEB  4, 1974

              ACT.      IND.      WITH
WT.           HP        HP        A/C
1750.         7.7       4.9        5.5
2000.         8.3       4.9        5.6
2250.         8.8       5.2        6.0
2500.         9.4       5.7        6.5
2750.         9.9       6.2        7.1
3000.        10.3       6.5        7.4
3500.        11.2       7.0        7.9
4000.        12.0       8.0        9.1
4500.        12.7       8.2        9.3
5000.        13.4       8.9       10.1
5500.        13.9       8.9       10.1
5500.        14.4       9.3       10.5

NOTE:  LAST 5500 VALUE IS FOR WTS ABOVE 5751#
```

```
  INPUT VALUES FOR
03 02-04-74    18.8 HP 1800 RPM = 46.3 MPH

   WT          T          IND. HP          ACT. HP          CALC. HP
 1750.       16.00         4.0              6.6               4.0
 2000.       17.00         4.0              7.1               3.9
 2500.       20.80         4.0              7.3               3.9
 3000.       25.00         4.0              7.3               3.9
 3500.       27.70         4.0              7.7               3.9
 4000.       32.70         4.0              7.4               4.0
 4500.       35.10         4.0              7.8               3.9
 5000.       38.10         4.0              8.0               3.9
 5500.       40.50         4.0              8.2               4.0
 1750.        9.30         8.0             11.4               3.9
 2000.        9.90         8.0             12.3               8.0
 2500.       12.40         8.0             12.2               8.2
 3000.       15.00         8.0             12.1               8.2
 3500.       17.00         8.0             12.5               8.1
 4000.       20.00         8.0             12.1               8.1
 4500.       21.70         8.0             12.6               8.1
 5000.       24.40         8.0             12.4               8.1
 5500.       25.60         8.0             13.0               8.0
 1750.        5.70        14.0             18.6               8.1
 2000.        6.40        14.0             19.0              14.0
 2500.        8.00        14.0             19.0              13.9
 3000.        9.70        14.0             18.8              13.9
 3500.       10.90        14.0             19.5              13.9
 4000.       13.00        14.0             18.7              14.0
 4500.       14.20        14.0             19.2              13.9
 5000.       16.00        14.0             19.0              13.9
 5500.       16.90        14.0             19.8              14.0
                                                              14.0
```

| | | |
|---|---|---|
| **EPA TEST PROCEDURE** | Number TP-203 | Page 1 of 6 |

SUBJECT

GAS ANALYZER CALIBRATION CURVE GENERATION

| | |
|---|---|
| Reference FEDERAL REGISTER, VOL. 38 NO. 209, Oct. 31, 1973 - 85.075-23 | Data Form No. 203-01 |
| Responsible Organization<br>CORRELATION/MAINTENANCE | Computer Program<br>SAQF: CURVEALL |
| Test Witness/Review<br>QUALITY ASSURANCE | Performance Interval<br>See Comments |
| Type of Test Report<br>COMPUTER PRINT-OUT (DEFLECTION VS CONCENTRATION) | Supersedes<br>New |
| Report Distribution QUALITY ASSURANCE, TEST OPERATIONS, CORRELATION AND MAINTENANCE | Superseded by |

REMARKS/COMMENTS

1.0 Calibration should be performed every 30 days, after any maintenance requiring re-alignment or when called for specifically by contract requirement.

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Chief | | |
| Lab Branch | Support Services Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

## 1.0 PURPOSE

Measurement of exhaust components requires that the deflections obtained during the analysis be converted to concentrations as accurately as possible. This document describes the procedure to be used to construct calibration curves for the instruments which measure hydrocarbons, oxides of nitrogen, carbon dioxide and carbon monoxide.

## 2.0 TEST ARTICLE DESCRIPTION

The instruments being calibrated are mounted in a console with provisions for: analysis of the exhaust sample; recording the instrument outputs; and suitable gas supplies for spanning and zeroing the instruments.

## 3.0 REFERENCES

3.1 Federal Register, Vol. 38, No. 209, Oct. 31, 1973 - 85.075-23

3.2 SAE XJ1094, "Constant Volume Sampler System for Exhaust Emission Measurement," Section 4. (Proposed)

3.3 Operators Manuals for In Use Analyzers

## 4.0 REQUIRED EQUIPMENT

4.1 Exhaust gas analysis console, equipped with the following instruments:

4.1.1 Hydrocarbons by flame ionization
Beckman Model 400 or equivalent

4.1.2 Carbon monoixde by non-dispersive infrared (NDIR)
Bendix Model 8501B or equivalent

4.1.3 Carbon dioxide by non-dispersive infrared (NDIR)
MSA Model 202 or Beckman Model 315B or equivalent

4.1.4 Oxides of nitrogen by chemiluminescence
Teco Model 10A or equivalent

4.1.5 Flow controls for selecting and monitoring the gases

4.2 Zero gas meeting the requirements specified in FR 85.075-23 (a)(2).

4.3 Calibration (standard) gas mixtures traceable to NBS and/or EPA primary standards.

4.4 Chart recorders capable of 0-100 deflections with accuracy of ±1 percent, and a readability of ±1 percent.

**Preceding page blank**

4.5 Read-out device in percent of scale.

- Computer interface
- DVM
- Meter

5.0 PRECAUTIONS

5.1 Safety - Reference safety manual "Safe Handling of Compressed Gases."

5.2 Meter chart reading, D.V.M. or other output devices should have a valid calibration tag.

5.3 Check that the proper set of standards are used for the particular range being calibrated as specified by Quality Assurance.

6.0 VISUAL INSPECTION

6.1 Verify that the instrument serial number is correct for the sample train.

6.2 Check instrument gain settings against those in the instrument log book.

6.3 Check instrument response time and noise level.

7.0 TEST ARTICLE PREPARATION

7.1 Check calibration gas mixture for proper cylinder and regulation pressures.

7.2 Special checks; Converter efficiency test procedure No. 303.

7.3 Adjust analyzers to optimum performance.

7.3.1 Reference analyzer operation manuals

## 8.0 TEST PROCEDURE

The calibration curve is constructed from the data collected as a result of performing the following sequence of steps:

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Zero the instrument using zero gas flowing at the same rate used for span and sample. The HC instrument must be zeroed with air, others with nitrogen or air. | ZERO DEFL. |
| 102 | Select desired range, introduce calibration gas with highest concentration for that range. Adjust output to reading obtained in previously monthly calibration or determine theoretical percent of scale (TPS) by<br>$\frac{\text{Cylinder Conc.}}{\text{Range Conc.}} \text{X100} = \text{TPS}$<br>TPS should never be greater than 99 percent. | RANGE |
| 103 | Introduce zero gas. If not zero, adjust. | ZERO DEFL. |
| 104 | Introduce highest span gas | CONCENTRATION/ DEFLECTION |
| 105 | Repeat 103 | |
| 106 | When steps 103 and 104 can be repeated without adjustment, go on to 107. If not within a reasonable period of time, follow instrument diagnostic and maintenance procedures. Ref. 3.3. | |
| 107 | Introduce each successively lower span gas until zero is repeated. | CONC & DEFL. |
| 108 | Introduce each successively higher span gas until highest reading is obtained. | CONC & DEFL. |
| 109 | Repeat steps 107 and 108 until all readings agree within ±0.25%. If not possible, perform instrument diagnostic and maintenance procedures. Ref. 3.3. | |
| 110 | Record average of all readings except zero on data form # 203-01 | DEFLECTIONS |

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 111 | Record the following information on the data sheet date, analyzer, train no., gas analyzer, range no., full scale concentration, analyzer vendor, NDIR cell length, units, flow rate set point, FID pressures, gain setting, recorder type used, operators initials, also cylinder numbers, and concentrations. | SEE DATA SHEET |

9.0 DATA INPUT

9.1 Complete form # 203-01.

9.2 Submit the form to the Data Branch for processing.

10.0 DATA ANALYSIS

10.1 Process data using "SAQF: CURVEALL"

11.0 DATA OUTPUT

11.1 Computer print of "Curveall Super Version" Recorder Deflection vs. Concentration.

12.0 ACCEPTANCE CRITERIA

12.1 Check for linearity of NOx and HC curves.

12.2 Insure that all calibration points fit within ±2% of the point value.

12.3 Insure that no major curve shift was indicated from last calibration.

13.0 QUALITY PROVISIONS

13.1 If data does not follow "Acceptance Criteria", reject calibration and institute corrective action.

13.2 If data is acceptable and curve update is desired, check the appropriate space on the Curveall Verification sheet and return it to the Data Branch.

13.3 If data was unacceptable, upon completion of required corrective action, institute recalibration.

## ANALYZER CALIBRATION
## CURVE GENERATION DATA

| DATE | ANALYZER TRAIN NO. | GAS ANALYZED | RANGE NO. | FULL SCALE CONC. | ANALYZER VENDOR | NDIR CELL LENGTH | UNITS | FLOW RATE SCFH | SET POINT "H2O | FID PRESSURES AIR | FID PRESSURES FUEL | FID PRESSURES SAMP | GAIN SETTINGS ZERO | GAIN SETTINGS SPAN | RECORDER TYPE USED | OPERATOR INITIALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| - - | | | | | | | | | | | | | | | | |

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

COMMENTS:

| CYLINDER NUMBER | CYLINDER CONC. | METER DEFL. |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

### SYMBOLS AND ABBREVIATIONS

GASES - $C_3H_8$, CO, $CO_2$, $NO_x$, $CH_4$

CELL LENGTH UNITS - IN, CM

RECORDER TYPE - TI (Texas Instr.), HW (Honeywell), LN (Leeds & Northrup), DVM (Digital Voltmeter), MIS (Other).

### RANGE NO. DESIGNATIONS

HC, CO, $NO_x$ (PPM)

01 - 0 - 10
02 - 0 - 25
03 - 0 - 50
04 - 0 - 100
05 - 0 - 250
06 - 0 - 500
07 - 0 - 1000
08 - 0 - 2500
09 - 0 - 5000

CO, $CO_2$ (%)

01 - 0 - 1.0%
02 - 0 - 2.5%
03 - 0 - 5.0%
04 - 0 - 10.0%
05 - 0 - 15.0%

HEXANE NDIR

01 - 0 - 1000 PPM HEX
02 - 0 - 10000 PPM HEX

PROGRAM: SAQF:CURVEALL.
10-30-73

FORM 203-01

```
                                          ********************************
                                          *** CURVEALL SUPER VERSION ***
                                          ********************************
CALIBRATION DATE : 05-20-75                                                            RECORDER DEFLECTION : CONCENTRATION CO
ANALYZER TRAIN   :    16                                     |                        |                        |                        |
GAS ANALYZED     :  CO              11       6666666666      |  0.0     0.0   | 25.0   894.79 | 50.0   2059.69 | 75.0   3512.82 |
RANGE NUMBER     :    09           111      666666666666     |  0.5    14.78  | 25.5   915.68 | 50.5   2085.46 | 75.5   3546.59 |
FULL SCALE CONC. :5000.0          1111      66        66     |  1.0    29.69  | 26.0   936.67 | 51.0   2111.34 | 76.0   3580.62 |
ANALYZER VENDOR  :  BECKMAN         11      66               |  1.5    44.73  | 26.5   957.76 | 51.5   2137.32 | 76.5   3614.92 |
NDIR CELL LENGTH :   0.0            11      66               |  2.0    59.91  | 27.0   978.96 | 52.0   2163.41 | 77.0   3649.49 |
SAMPLE FLOW-RATE :   0.0 SCFH       11      66666666666      |  2.5    75.23  | 27.5  1000.26 | 52.5   2189.60 | 77.5   3684.35 |
MONITOR SET POINT:  13.0 "H20       11      666666666666     |  3.0    90.67  | 28.0  1021.67 | 53.0   2215.90 | 78.0   3719.49 |
FID AIR  PRESSURE:   0.0  PSI       11      66        66     |  3.5   106.25  | 28.5  1043.18 | 53.5   2242.32 | 78.5   3754.93 |
FID FUEL PRESSURE:   0.0  PSI       11      66        66     |  4.0   121.97  | 29.0  1064.78 | 54.0   2268.84 | 79.0   3790.68 |
FID SAMP PRESSURE:   0.0  PSI       11      66        66     |  4.5   137.81  | 29.5  1086.50 | 54.5   2295.47 | 79.5   3826.73 |
ZERO GAIN        :   0.0        1111111111  666666666666     |                |                |                |                |
SPAN GAIN        :   0.0        1111111111   6666666666      |  5.0   153.79  | 30.0  1108.31 | 55.0   2322.22 | 80.0   3863.10 |
RECORDER TYPE    :   DVM                                     |  5.5   169.90  | 30.5  1130.22 | 55.5   2349.09 | 80.5   3899.80 |
OPERATOR'S INIT. :    RR                                     |  6.0   186.14  | 31.0  1152.23 | 56.0   2376.07 | 81.0   3936.84 |
COMMENTS         : 0-5000 PPM CO                             |  6.5   202.51  | 31.5  1174.34 | 56.5   2403.17 | 81.5   3974.22 |
                                                             |  7.0   219.01  | 32.0  1196.54 | 57.0   2430.39 | 82.0   4011.96 |
                                                             |  7.5   235.64  | 32.5  1218.85 | 57.5   2457.74 | 82.5   4050.05 |
                                                             |  8.0   252.40  | 33.0  1241.25 | 58.0   2485.21 | 83.0   4088.52 |
                                                             |  8.5   269.29  | 33.5  1263.75 | 58.5   2512.80 | 83.5   4127.37 |
   EQUATION:                                                 |  9.0   286.31  | 34.0  1286.35 | 59.0   2540.52 | 84.0   4166.61 |
   ********                                                  |  9.5   303.45  | 34.5  1309.04 | 59.5   2568.38 | 84.5   4206.25 |
                        2        3                           |                |                |                |                |
      CO = X / ( A + B*X + C*X  + D*X  )                     | 10.0   320.73  | 35.0  1331.83 | 60.0   2596.36 | 85.0   4246.30 |
                                                             | 10.5   338.12  | 35.5  1354.72 | 60.5   2624.49 | 85.5   4286.78 |
   COEFFICIENTS:                                             | 11.0   355.65  | 36.0  1377.70 | 61.0   2652.75 | 86.0   4327.69 |
   ************                                              | 11.5   373.30  | 36.5  1400.77 | 61.5   2681.15 | 86.5   4369.05 |
                                                             | 12.0   391.07  | 37.0  1423.94 | 62.0   2709.69 | 87.0   4410.87 |
        (A)    3.3993E-02                                    | 12.5   408.97  | 37.5  1447.21 | 62.5   2738.37 | 87.5   4453.15 |
        (B)   -3.1195E-04                                    | 13.0   426.99  | 38.0  1470.57 | 63.0   2767.21 | 88.0   4495.93 |
        (C)    3.2324E-06                                    | 13.5   445.14  | 38.5  1494.02 | 63.5   2796.20 | 88.5   4539.19 |
        (D)   -1.7609E-08                                    | 14.0   463.41  | 39.0  1517.57 | 64.0   2825.34 | 89.0   4582.97 |
                                                             | 14.5   481.80  | 39.5  1541.21 | 64.5   2854.64 | 89.5   4627.28 |
                                                             |                |                |                |                |
                                                             | 15.0   500.30  | 40.0  1564.95 | 65.0   2884.09 | 90.0   4672.12 |
  CYLINDER     RECORDER    CO   CONCENTRATIONS    % POINT    | 15.5   518.93  | 40.5  1588.78 | 65.5   2913.71 | 90.5   4717.52 |
   NUMBER     DEFLECTION  CYLINDER  CALCULATED   DEVIATION   | 16.0   537.68  | 41.0  1612.70 | 66.0   2943.50 | 91.0   4763.49 |
************  **********  ********  **********   *********   | 16.5   556.55  | 41.5  1636.72 | 66.5   2973.46 | 91.5   4810.04 |
                 (X)                   (Y)                   | 17.0   575.54  | 42.0  1660.83 | 67.0   3003.59 | 92.0   4857.20 |
A2827           26.90     975.172    974.712      -0.15      | 17.5   594.64  | 42.5  1685.04 | 67.5   3033.91 | 92.5   4904.98 |
RR1594          40.40    1576.669   1584.002       0.47      | 18.0   613.86  | 43.0  1709.34 | 68.0   3064.40 | 93.0   4953.40 |
A8442           56.10    2396.865   2381.482      -0.64      | 18.5   633.20  | 43.5  1733.73 | 68.5   3095.07 | 93.5   5002.47 |
A3347           71.60    3283.272   3302.510       0.59      | 19.0   652.65  | 44.0  1758.22 | 69.0   3125.94 | 94.0   5052.23 |
A6146           83.90    4170.984   4158.727      -0.29      | 19.5   672.21  | 44.5  1782.81 | 69.5   3157.00 | 94.5   5102.67 |
A9172           95.30    5182.027   5184.883       0.06      |                |                |                |                |
                                                             | 20.0   691.89  | 45.0  1807.49 | 70.0   3188.26 | 95.0   5153.83 |
        AVERAGE PERCENT OF POINT DEVIATION:  0.37            | 20.5   711.69  | 45.5  1832.27 | 70.5   3219.73 | 95.5   5205.73 |
                                                             | 21.0   731.59  | 46.0  1857.15 | 71.0   3251.40 | 96.0   5258.39 |
                                                             | 21.5   751.61  | 46.5  1882.12 | 71.5   3283.28 | 96.5   5311.84 |
                                                             | 22.0   771.73  | 47.0  1907.19 | 72.0   3315.38 | 97.0   5366.09 |
                                                             | 22.5   791.97  | 47.5  1932.35 | 72.5   3347.70 | 97.5   5421.17 |
                                                             | 23.0   812.32  | 48.0  1957.62 | 73.0   3380.24 | 98.0   5477.10 |
                   ***PROCESSED:  15:43  MAY 20, 1975        | 23.5   832.78  | 48.5  1982.99 | 73.5   3413.02 | 98.5   5533.92 |
                                                             | 24.0   853.34  | 49.0  2008.45 | 74.0   3446.04 | 99.0   5591.65 |
                          ***LOGGED ON LINE:  399            | 24.5   874.01  | 49.5  2034.02 | 74.5   3479.31 | 99.5   5650.32 |
                          ***TO: 162/209 05-20-75            |                |                |                |                |
```

|  |  |  |
|---|---|---|
| **EPA TEST PROCEDURE** | Number TP-204 | Page 1 of 3 |

SUBJECT
CHART RECORDER/MAINTENANCE

|  |  |
|---|---|
| Reference<br>MANUFACTURER'S SERVICE MANUALS | Data Form No.<br>INSTR. LOGBOOK |
| Responsible Organization<br>INSTRUMENT SERVICES | Computer Program<br>NONE |
| Test Witness/Review<br>INSTRUMENT SERVICES LEADER/QUALITY ASSURANCE | Performance Interval<br>MINIMUM: 90 DAYS |
| Type of Test Report<br>CALIBRATION STICKER AND LOG BOOK ENTRY | Supersedes<br>New |
| Report Distribution<br>QUALITY ASSURANCE, INSTRUMENT SERVICES | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance |  |  |
| Lab Branch | Chief |  |  |
| Lab Branch | Support Services Chief |  |  |
|  |  |  |  |
|  |  |  |  |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
|  |  |  |  |

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## 1.0 PURPOSE

To perform periodic recalibration and maintenance after periods of use or questionable performance. Recalibration will assure accurate instrument output and prolong the useful life of the instrument.

## 2.0 TEST ARTICLE DESCRIPTION

2.1 Chart recorder, two channel model capable of measuring two variables on the same chart. The recorder is a continuous balance potentiometer which responds to a d-c signal representing the value of the measured quantity.

2.2 Typical chart recorders used may be:

- Honeywell 194 Electronik
- Varian G-14A-2
- Varian G-1110
- Hewlett-Packard 680
- Texas Instruments 4525-2, 7822-2 (4 pen)
- Texas Instruments 2596-2 (2 pen)

## 3.0 REFERENCES

Each recorder listed in 2.2 has a manual showing theory/operation, maintenance and calibration procedures. These manuals are available and should be reviewed by the instrument technicians.

## 4.0 REQUIRED EQUIPMENT

The list of equipment in this section represents an example of the articles needed to perform a valid calibration. It should be noted that manufacturers of specific equipment may list requirements for their own calibration items.

4.1 Example of calibration equipment

- Calibrated precision voltage source.
  Example: Honeywell Model 2746 portable potentiometer, 0-200 microvolt to 0-500 millivolt ranges.

- Test leads (preferably with banana plugs)
- Calibration screwdrivers (1/8" and 1/4" bits)

## 5.0 PRECAUTIONS

5.1 Calibration and adjustment of recorders should be accomplished by Instrument Service Technicians only.

5.2 Safety precautions should be observed in using electrical equipment.

| REVISIONS: | CHART RECORDER CALIBRATION/MAINTENANCE<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-204<br>**PAGE** 3 **OF** 3 |
|---|---|---|

## 6.0 VISUAL INSPECTION

6.1 Inspect slidewires for signs of wear.

6.2 Inspect RECORDER for disconnected leads and/or broken wires.

## 7.0 TEST ARTICLE PREPARATION

7.1 Set up calibration equipment as specified in applicable service manual.

## 8.0 TEST PROCEDURE

Each manufacturer of chart recorders outlines specific calibration procedures common to their product. Therefore, the test procedures for chart recorder calibration should be taken from the manufacturer's text. It is also suggested that routine maintenance should be accomplished prior to the calibration of each recorder.

## 9.0 DATA INPUT

9.1 The date of calibration, type of instrument, serial number, and work performed is recorded in instrument calibration log book (see attachment).

## 10.0 DATA ANALYSIS

10.1 Observed readings and calibration input should be compared.

## 11.0 DATA OUTPUT

11.1 Calibration sticker showing the date of calibration and the date the next calibration is due is attached to the recorder. Calibration data sheet shall be filed in the instrument file and logged in the record book.

## 12.0 ACCEPTANCE CRITERIA

12.1 Recorder must function within ±1 percent accuracy and repeatability following calibration.

## 13.0 QUALITY PROVISIONS

13.1 Check to assure calibration has been completed at proper time intervals.

13.2 Assure that calibration sticker has been placed on recorder.

TP-204 ATTACHMENT No. 1
INSTRUMENT SERVICES LOG BOOK

| MAKE | MODEL | SERIAL NO. | DATE CALIBRATED | DATE DUE | TECH. | REMARKS |
|---|---|---|---|---|---|---|
| ESTERLINE | E1124E | 940456 | 8-29-74 | 11-29-74 | D.P. | REPLACED INK PAD & PRINT WHE |
| " | " | 940757 | 10-11-74 | 1-11-75 | D.P. | 1° LOW PRIOR TO CAL. |
| HONEYWELL | [illegible] | [illegible] | 12-7-74 | 3-7-75 | J " | GAIN HIGH PRIOR TO CAL |
| TEX INST | [illegible] | [illegible] | 12-3-74 | 3-3-75 | " | REPAIRED SLIDE WIRE |

**EPA TEST PROCEDURE**

Number TP-205

Page 1 of 4

SUBJECT
TEMPERATURE RECORDER CALIBRATION/MAINTENANCE

| | |
|---|---|
| Reference<br>MANUFACTURER'S SERVICE MANUAL | Data Form No.<br>LOG BOOK |
| Responsible Organization<br>INSTRUMENT SERVICES | Computer Program<br>NONE |
| Test Witness/Review<br>INSTRUMENT SERVICES LEADER, QUALITY ASSURANCE | Performance Interval<br>MINIMUM: 90 DAYS |
| Type of Test Report<br>LOG BOOK ENTRY AND CALIBRATION STICKER | Supersedes<br>NEW |
| Report Distribution<br>QUALITY ASSURANCE, INSTRUMENT SERVICES | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Chief | | |
| Lab Branch | Support Services Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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| REVISIONS: | TEMPERATURE RECORDER CALIBRATION/MAINTENANCE | PROCEDURE NO.<br>TP-205 |
|---|---|---|
|  | **TEST PROCEDURE** | PAGE 2 OF 4 |

1.0 PURPOSE

To perform periodic re-calibration and maintenance after periods of use and/or questionable performance. Re-calibration of temperature recorders will assure accurate instrument output and prolong the instrument's useful life.

2.0 TEST ARTICLE DESCRIPTION

Temperature recorders vary in make, however, the operating principles are generally the same. A temperature probe (normally iron-constantan thermocouple) senses the temperature and produces an unknown voltage which is in turn subtracted from a known voltage. The difference in voltages is amplified and displayed by the recorder

2.1 Temperature recorders vary in application, ranging from one channel to as many as 24 channels for measuring independent variables.

The following recorders are representative of the types used in emission monitoring.

- o Esterline Corp., 24-channel, Model E1124E
- o Honeywell, 24-channel, Model Elect. 19
- o Honeywell, multi-channel, Model Elect 15
- o Rustrax, single-channel, Model 2133

3.0 REFERENCES

Each recorder listed in 2.1 has a manual showing theory/operation, maintenance and calibration procedures. Manuals of this nature must be made available to the instrument technicians.

4.0 REQUIRED EQUIPMENT

The list of equipment in this section represents an example of the articles needed to perform a valid calibration. It should be noted that manufacturers of specific equipment may list requirements for their own calibration items.

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4.1 Example of calibration equipment

- Precision voltage source (used for input voltages from temperature-EMF equivalents) reference 0° C or 32° F.
- Thermocouple extension wire
- Ice bath for 0° C or 32° F reference.
- Reference standard, Hewlett-Packard temperature indicator - Quartz digital

## 5.0 PRECAUTIONS

5.1 Dangerous stray voltages exist. Before touching connections, turn off power and check each terminal with a multimeter.

5.2 Calibration and adjustment of recorders should be accomplished by Instrument Service technicians only.

## 6.0 VISUAL INSPECTION

6.1 Inspect for obvious signs of wear.

6.2 Inspect for disconnected leads and/or broken wires.

## 7.0 TEST ARTICLE PREPARATION

7.1 Set up calibration equipment as specified in applicable service manual.

## 8.0 TEST PROCEDURE

Each manufacturer of temperature recorders outlines specific calibration procedures common to their product. Therefore, the test procedures for the recorder calibration should be taken from the manufacturer's text. It is also suggested that routine maintenance should be accomplished prior to the calibration of each recorder.

## 9.0 DATA INPUT

9.1 The date of calibration, type of instrument, serial number, and work performed is recorded in instrument calibration log book (see attachment).

| REVISIONS: | TEMPERATURE RECORDER CALIBRATION/MAINTENANCE<br>**TEST PROCEDURE** | **PROCEDURE NO.**<br>TP-205<br>**PAGE** 4 **OF** 4 |
|---|---|---|

10.0 DATA ANALYSIS

10.1 Compare observed temperature readings with the reference standard.

11.0 DATA OUTPUT

11.1 Calibration sticker showing the date of calibration and the date the next due calibration is attached to the recorder.

11.2 Information regarding the results of the calibration shall be filed with the instrument records.

12.0 ACCEPTANCE CRITERIA

12.1 Temperature recorder must indicate ambient temperature within ±2 degrees of the true value.

12.2 Temperature indicated must be within 1 percent of full scale at all points.

13.0 QUALITY PROVISIONS

13.1 If acceptance criteria are not met, repair instrument and/or repeat calibration.

TP-205 ATTACHMENT No. 1

## INSTRUMENT SERVICES LOG BOOK

| MAKE | MODEL | SERIAL NO. | DATE CALIBRATED | DATE DUE | TECH. | REMARKS |
|---|---|---|---|---|---|---|
| ESTERLINE | E1124E | 940456 | 8-29-74 | 11-29-74 | D.P. | CLEANED INK PAD & PRINT WHEEL |
| " | " | 940757 | 10-11-74 | 1-11-75 | D.P. | 1° LOW PRIOR TO CAL. |
| HONEYWELL | 194C | 5105576 | 12-7-74 | 3-7-75 | J | GAIN HIGH PRIOR TO CAL |
| TEX. INSTR | 1596-2 | [illegible] | 12-9-74 | 3-9-75 | [illegible] | REPAIRED SLIDE WIRE |

# EPA TEST PROCEDURE

Number TP-206

Page 1 of 9

SUBJECT
BAROMETRIC PRESSURE
CALIBRATION AND CORRELATION

| | |
|---|---|
| Reference Federal Register, Vol. 39, No. 101, May 23, 1974, 85.075-22(j) | Data Form No.<br>Log Book |
| Responsible Organization<br>Chemical Analysis | Computer Program<br>None |
| Test Witness/Review<br>Correlation and Maintenance | Performance Interval<br>Monthly |
| Type of Test Report<br>Log Book Entry | Supersedes<br>New |
| Report Distribution Chemistry Section, Support Services | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt. | Quality Assurance | | |
| Lab. Branch | Chief | | |
| Lab. Branch | Support Services Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

## 1.0 PURPOSE

To calibrate the aneroid barometers used in the test call against a Fortin type barometer to assure accurate and uniform test cell readings.

## 2.0 TEST ARTICLE DESCRIPTION

Aneroid barometer compensated for temperature, brass, scale 25.1-31.1 inches of mercury (Hg), 0.02 subdivisions.

## 3.0 REFERENCES

3.1 PRINCO Barometer Instruction Booklet

3.2 W.G. Brombacher, D.P. Johnson, and J.L. Cross.,
"Mercury Barometers and Manometers"
NBS Monograph 8, May 1960.

## 4.0 REQUIRED EQUIPMENT AND CONDITIONS

4.1 Fortin type barometer, 1/4 inch bore, reading by vernier to 0.01 in. Hg

4.2 Rack for hanging the aneroid barometers

4.3 Temperature controlled room of ±3°F.

## 5.0 PRECAUTIONS

5.1 The Fortin type barometer readings are corrected for temperature and gravity. The aneroid barometer is set to the corrected barometer reading.

5.2 The aneroid barometers may indicate a slightly different reading from one cell to another due to variations in the air handling system. Large variations indicate a need for calibration or replacement.

5.3 Important factors which could affect the reading of the height of the mercury are

- Lighting - Proper illumination is essential to define the location of the crown of the meniscus. Precision meniscus sighting under optimum viewing conditions can approach ± 0.001 in. Contact between index and mercury surface in the cistern, judged to be made when a small dimple in the mercury first disappears during adjustment, can be detected with proper lighting to much better than ± 0.001 in.

- Temperature - To keep the uncertainty in height within 0.01% (0.003 in. Hg), the mercury temperature must known within

$\pm 1^{\circ}$F. Although it is generally assumed that the scale and mercury temperatures are identical, the scale temperature need not be known to better than $\pm 10^{\circ}$F for comparable accuracy. Uncertainties caused by nonequilibrium conditions could be avoided by installing the barometer in a uniform temperature room.

- Alignment - Vertical alignment of the barometer tube is required for an accurate pressure determination. The Fortin barometer, designed to hang from a hook, does not of itself hang vertically. This must be accomplished by a separately supported ring encircling the cistern; adjustment screws control the horizontal position.

- Readings - The most reliable readings are obtained when the temperature has not changed greatly over the past four hours. When reading the barometer the reader's eye should be in the same horizontal plane as the top of the mercury meniscus and the lower edge of the vernier plate. This position can be checked by getting the eye in line with the bottom of the vernier plate and the bottom of the metal guide in back of the mercury column directly in back of the vernier plate.

  Readjustment to zero should be made whenever necessary in reading the barometer; i.e., the adjusting screw at the bottom of the reservoir casing should be manipulated until the surface of the mercury exactly coincides with the tip of the ivory zero point which is visible inside the reservoir.

  The height of the meniscus will be greater on a rising barometer than on a falling barometer. In order to bring the meniscus to its approximate average height, tap the barometer lightly with your fingers before taking a reading.

5.4 If it is desired to convert an english reading to a metric reading, or vice versa, always apply the temperature and gravity corrections before making conversion.

## 6.0 VISUAL INSPECTION

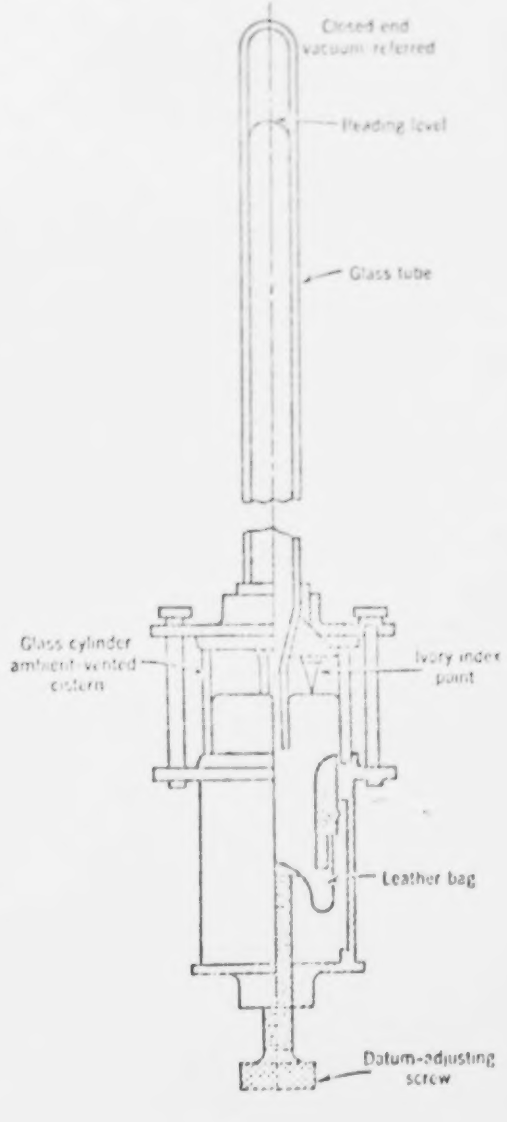
6.1 If an aneroid barometer has a cracked glass or dented case the complete barometer should be replaced. Do not attempt to recalibrate as the internal movements may have been also damaged.

6.2 If the mercury appears dull or tarnished, it is an indication that the mercury has become contaminated in some way. It frequently occurs when air, dirt, and moisture are admitted into the barometer tube. In such event the instrument will no longer give accurate readings. For proper cleaning the instrument should be returned to the factory.

## 7.0 TEST ARTICLE PREPARATION

7.1 The aneroid barometers to be calibrated should be hung in the ±3°F temperature controlled room for a minimum of 4 hours to allow them to come to equilibrium with the ambient conditions.

A Fortin-type barometer.


Closed end
vacuum referred
Reading level
Glass tube
Glass cylinder
ambient vented
cistern
Ivory index
point
Leather bag
Datum-adjusting
screw

## 8.0 TEST PROCEDURE

The test requires three basic procedures: A. Reading the mercury barometer, B. Calibration of the aneroid barometer and C. Correlation of the test cell barometers.

| Test Sequences | Test Description | Data Output |
|---|---|---|
| 101A | In reading a barometer of the Fortin type, which is the usual laboratory precision type, first obtain the temperature of the case from the small thermometer attached midway between the top and bottom of the instrument. Then adjust the mercury in the reservoir to the fixed point (an ivory pin), so that the tip of the pin and its image upon the mercury surface coincide. Tap the barometer case gently to be sure that the mercury is not stuck in the tube and verify the zero setting. Now bring the vernier down until the white background is cut off at the highest point of the meniscus. The reading is the uncorrected barometric height. | Pressure, un-corrected |
| 102A | The standard temperature for the English scales is 62°F.; the standard temperature for the Metric scales is 0°C. The standard temperature for the density of mercury is 0°C. or 32°F. Since the scales and the mercury have different coefficients or expansion, the pressure indications will be affected by variations in temperature; therefore, in order to obtain the true pressure every reading must be corrected for temperature. The Temperature Correction Tables combines the corrections for length of the scales and the density of mercury. | Temperature correction factor |
| | Further, the pressure indication will be affected by the gravity of the place at which the reading is taken. Latitudes from 0° to 45° have a subtractive correction; latitudes from 46° to 90° have an additive correction. More precise | Gravity correction factor |

| Test Sequence | Test Description | Data Output |
|---|---|---|
| | determinations of the true pressure may be made by using the Gravity Correction Tables in conjunction with the observed readings corrected for temperature. | |
| | EXAMPLE; Assume the barometer reads 29.91" at a temperature of 75°F. Table 1 gives the temperature correction for every two degrees Fahrenheit and every one inch of atmospheric pressure. Interpolating, we find the correction to be -.125". The reading corrected for temperature, therefore, is 29.91" -.125', or 29.785". If the reading is being taken at a latitude of 42° the correction for gravity given in Table 2 is -.010" which makes the true pressure 29.785" -.010, or 29.775" which, if working to one hundredths of an inch, could be rounded off to 29.78". | |
| 101B | After the aneroid barometers have attained equilibrium read the Fortin barometer and adjust the aneroid barometers at the corrected reading using the adjusting screw on the back of the barometer. Gently tap each gauge before taking the reading. Cover the adjusting screw with a piece of tape to discourage tampering. | Calib. Date<br>Log Book<br>Entry |
| 101C | Correlation is accomplished by reading all the test cell barometers in their usual position once a week. | Log Book<br>Entry By<br>I.D. Number |

## TEMPERATURE CORRECTION TABLE — Table 1 — English System

**To reduce the reading of the barometer to standard temperature**

| Temperature in Degrees F. | Observed Reading of the Barometer in inches | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20" | 21" | 22" | 23" | 24" | 25" | 26" | 27" | 28" | 29" | 30" | 31" |
| | ALL CORRECTIONS SUBTRACTIVE | | | | | | | | | | | |
| 60° | 0.057 | 0.060 | 0.062 | 0.065 | 0.068 | 0.071 | 0.074 | 0.077 | 0.080 | 0.082 | 0.085 | 0.088 |
| 62 | .060 | .063 | .066 | .069 | .073 | .076 | .079 | .082 | .085 | .088 | .091 | .094 |
| 64 | .064 | .067 | .070 | .074 | .077 | .080 | .083 | .086 | .090 | .093 | .096 | .099 |
| 66 | .068 | .071 | .074 | .078 | .081 | .085 | .088 | .091 | .095 | .098 | .101 | .105 |
| 68 | .071 | .075 | .078 | .082 | .085 | .089 | .093 | .096 | .100 | .103 | .107 | .110 |
| 70 | .075 | .079 | .082 | .086 | .090 | .094 | .097 | .101 | .105 | .109 | .112 | .116 |
| 72 | .078 | .082 | .086 | .090 | .094 | .098 | .102 | .106 | .110 | .114 | .118 | .122 |
| 74 | .082 | .086 | .090 | .094 | .098 | .103 | .107 | .111 | .115 | .119 | .123 | .127 |
| 76 | .086 | .090 | .094 | .098 | .103 | .107 | .111 | .116 | .120 | .124 | .128 | .133 |
| 78 | .089 | .094 | .098 | .103 | .107 | .112 | .116 | .120 | .125 | .129 | .134 | .138 |
| 80 | .093 | .097 | .102 | .107 | .111 | .116 | .121 | .125 | .130 | .135 | .139 | .144 |
| 82 | .096 | .101 | .106 | .111 | .116 | .121 | .125 | .130 | .135 | .140 | .145 | .149 |
| 84 | .100 | .105 | .110 | .115 | .120 | .125 | .130 | .135 | .140 | .145 | .150 | .155 |
| 86 | .104 | .109 | .114 | .119 | .124 | .130 | .135 | .140 | .145 | .150 | .155 | .161 |
| 88 | .107 | .113 | .118 | .123 | .129 | .134 | .139 | .145 | .150 | .155 | .161 | .166 |
| 90 | .111 | .116 | .122 | .127 | .133 | .138 | .144 | .150 | .155 | .161 | .166 | .172 |
| 92 | .114 | .120 | .126 | .132 | .137 | .143 | .149 | .154 | .160 | .166 | .172 | .177 |
| 94 | .118 | .124 | .130 | .136 | .142 | .147 | .153 | .159 | .165 | .171 | .177 | .183 |
| 96 | .122 | .128 | .134 | .140 | .146 | .152 | .158 | .164 | .170 | .176 | .182 | .188 |
| 98 | .125 | .131 | .138 | .144 | .150 | .156 | .163 | .169 | .175 | .181 | .188 | .194 |
| 100 | .129 | .135 | .142 | .148 | .154 | .161 | .167 | .174 | .180 | .187 | .193 | .200 |

| REVISIONS: | BAROMETRIC PRESSURE<br>CALIBRATION & CORRELATION<br>TEST PROCEDURE | PROCEDURE NO.<br>TP-206<br>PAGE 8 OF 9 |
|---|---|---|

## GRAVITY CORRECTION TABLE — Table 2 — English System

To reduce the reading of the barometer to standard gravity

LATITUDE 0° TO 45° THE CORRECTION IS TO BE SUBTRACTED
LATITUDE 46° TO 90° THE CORRECTION IS TO BE ADDED

| Latitude | Observed Reading of the Barometer in Inches | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20" | 21" | 22" | 23" | 24" | 25" | 26" | 27" | 28" | 29" | 30" |
| 0° | −0.054 | −0.056 | −0.059 | −0.062 | −0.064 | −0.067 | −0.070 | −0.072 | −0.075 | −0.078 | −0.080 |
| 5 | .053 | .055 | .058 | .061 | .063 | .066 | .069 | .071 | .074 | .077 | .079 |
| 10 | .050 | .053 | .055 | .058 | .060 | .063 | .066 | .068 | .071 | .073 | .076 |
| 15 | .047 | .049 | .051 | .053 | .056 | .058 | .060 | .063 | .065 | .067 | .070 |
| 20 | .041 | .043 | .045 | .047 | .050 | .052 | .054 | .056 | .058 | .060 | .062 |
| 25 | .035 | .037 | .038 | .040 | .042 | .043 | .045 | .047 | .049 | .050 | .052 |
| 30 | .027 | .029 | .030 | .031 | .033 | .034 | .035 | .037 | .038 | .040 | .041 |
| 32 | .024 | 025 | .026 | .028 | .029 | .030 | .031 | .032 | .034 | .035 | .036 |
| 34 | .021 | .022 | 023 | .024 | .025 | .026 | .027 | .028 | .029 | .030 | .031 |
| 36 | .017 | .018 | .019 | .020 | .021 | .022 | .022 | .023 | .024 | .025 | .026 |
| 38 | .014 | .014 | .015 | .016 | .016 | .017 | .018 | .018 | .019 | .020 | .020 |
| 40 | .010 | .011 | .011 | .012 | .012 | .013 | .013 | .014 | .014 | .015 | .015 |
| 42 | .006 | .007 | .007 | .007 | .008 | .008 | .008 | .009 | .009 | .009 | .010 |
| 44 | −0.003 | −0.003 | −0.003 | −0.003 | −0.003 | −0.003 | −0.004 | −0.004 | −0.004 | −0.004 | −0.004 |
| 46 | +0.001 | +0.001 | +0.001 | +0.001 | +0.001 | +0.001 | +0.001 | +0.001 | +0.001 | +0.001 | +0.001 |
| 48 | .005 | .005 | .005 | .005 | .006 | .006 | .006 | .006 | .006 | .007 | .007 |
| 50 | .008 | .009 | .009 | .010 | .010 | .010 | .011 | .011 | .012 | .012 | .012 |
| 55 | .017 | .018 | .019 | .020 | .021 | .021 | .022 | .023 | .024 | .025 | .026 |
| 60 | .026 | .027 | .028 | .029 | .031 | .032 | .033 | .034 | .036 | .037 | .038 |
| 65 | .033 | .035 | .036 | .038 | .040 | .041 | .043 | .045 | .046 | .048 | .050 |
| 70 | .040 | .042 | .044 | .046 | .048 | .050 | .052 | .053 | .055 | .057 | .059 |
| 75 | .045 | 0.47 | .049 | .052 | .054 | .056 | .058 | .061 | .063 | .065 | .067 |
| 80 | .049 | .051 | .054 | .056 | .059 | .061 | .063 | .066 | .068 | .071 | .073 |
| 85 | .051 | .054 | .056 | .059 | .061 | .064 | .067 | .069 | .072 | .074 | .077 |
| 90 | +0.052 | +0.055 | +0.057 | +0.060 | +0.062 | +0.065 | +0.068 | +0.070 | +0.073 | +0.075 | +0.078 |

| | | |
|---|---|---|
| **REVISIONS:** | BAROMETRIC PRESSURE<br>CALIBRATION & CORRELATION<br>**TEST PROCEDURE** | **PROCEDURE NO.**<br>TP-206<br>**PAGE** 2 **OF** 2 |

9.0 DATA INPUT

9.1 Enter calibration dates in log book by I.D. number. Indicate adjusted or not adjusted.

9.2 Enter the amount of deviation from true barometric pressure in the instrument log book.

10.0 DATA ANALYSIS

None required

11.0 DATA OUTPUT

11.1 A handwritten copy of the correlation data goes to Quality Assurance management.

12.0 ACCEPTANCE CRITERIA

12.1 In order to achieve 0.1% accuracy the barometer readings should correlate among themselves within ± 0.01 in. Hg.

12.2 Correlation should be established over 28.5 to 30.0 in. Hg. range.

13.0 QUALITY PROVISIONS

13.1 At the Factory the Fortin-Type Barometers are adjusted as nearly as possible to a zero correction by comparison with a certified standard. The adjustment is so made that no further correction for capillarity need be made.

## Section 4.0

## VERIFICATION

**EPA TEST PROCEDURE**

Number TP-301

Page 1 of 8

SUBJECT

CVS SYSTEM VERIFICATION BY TRACER GAS INJECTION

Reference FEDERAL REGISTER, VOL. 138, NO. 124, June 28, 1973 - Appendix III

Data Form No. 301-01

Responsible Organization CORRELATION/MAINTENANCE

Computer Program SAQF: CALIBCK

Test Witness/Review QUALITY ASSURANCE

Performance Interval SEE WEEKLY/SEC 13.0

Type of Test Report COMPUTER PRINT-OUT

Supersedes NEW

Report Distribution QUALITY ASSURANCE/TEST OPERATIONS/CORRELATION & MAINTENANCE

Superseded by

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Chief | | |
| Lab Branch | Test Operations Chief | | |
| Lab Branch | Support Services Chief | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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## 1.0 PURPOSE

To verify that the CVS sampling system, its associated analyzers, and subsequent data analysis will determine the correct mass value of a quantity of gas injected into the system. The actual or theoretical mass value is compared to the indicated mass value to obtain the accuracy (% error) of the system.

## 2.0 TEST ARTICLE DESCRIPTION

2.1 A constant volume sample which meets the requirements stated in Federal Register 85.075-20 (see procedure # 201 for calibration procedure).

2.2 A gas analysis system meeting requirements in Federal Register 85.075-20.

## 3.0 REFERENCES

3.1 Federal Register, Vol. 38, No. 124, Appendix III and 85.075-20.

3.2 EPA, Ann Arbor, Preventive Maintenance Guideline, Section V.

## 4.0 REQUIRED EQUIPMENT

4.1 Equipment required for "Bomb Method"

4.1.1 Supply cylinder of pure tracer gas. Normally propane is used, however carbon monoxide (CO) may be used as an alternative.

4.1.2 Small laboratory cylinder filled with pure tracer gas from the supply cylinder. The "bombs" normally have a volume of 16,000 cubic centimeters.

4.1.3 Injection fitting.

4.1.4 Analytical balance for weighing cylinder (see procedure # 101, sec. 7.2, for calibration procedure).

4.2 Equipment required for Critical Flow Orifice (CFO) method.

4.2.1 Supply cylinder of 99.5% pure tracer gas

4.2.2 CFO kit.

4.2.3 Injection fitting.

4.2.4 Thermometer.

## 5.0 PRECAUTIONS

5.1 Carbon monoxide is an odorless, extremely poisonous gas. Therefore, when it is used as a tracer gas, the safety precautions outlined below must be observed.

1. Two operators experienced in pressurized gas handling should be in attendance.

2. Provide adequate ventilation in the work area. Turn on the dynamometer test cooling fan.

3. Before connecting the CFO kit to the CO bottle, prepare the SAF-CO-Meter bulb for use as specified in the instructions provided. Check storage date on the glass ampoules.

4. After connecting the CO bottle, with the CVS running and the CFO outlet line inserted into the exhaust plenum, open the CO bottle valve just enough to show full bottle pressure on the regulator high pressure gauge. Starting at the bottle valve, check for leaks at all fittings using soap solution and/or the SAF-CO-Meter. If a leak is discovered, close the CO bottle valve first before retightening or servicing.

5. Use the SAF-CO-Meter to monitor ambient air during the test.

6. Shut off the CO bottle valve before stopping the CVS.

## 6.0 VISUAL INSPECTION

6.1 Inspect the equipment set-up to insure the system is leak-tight.

## 7.0 TEST ARTICLE PREPARATION

7.1 Preparation for "Bomb" injection.

7.1.1 Fill the evacuated bomb cylinder with tracer gas from the supply cylinder. The regulator (output) should be set at 40 PSIG for propane (blue cylinder) and 80 PSIG for carbon monoxide (gray cylinder). Transfer the gas for three minutes.

7.1.2 Run the CVS for five minutes and allow the pump inlet temperature to stabilize at 100°F. Attach the injection fitting and the auxiliary temperature sensor to the spare fitting on the pump elbow.

7.1.3 Zero the CVS counters, timer and evacuate the sample/background bags. Replace sample filter and assure the filter holder is completely closed. Set the flow rates at 5.0 cfh.

7.2 Preparation for CFO method.

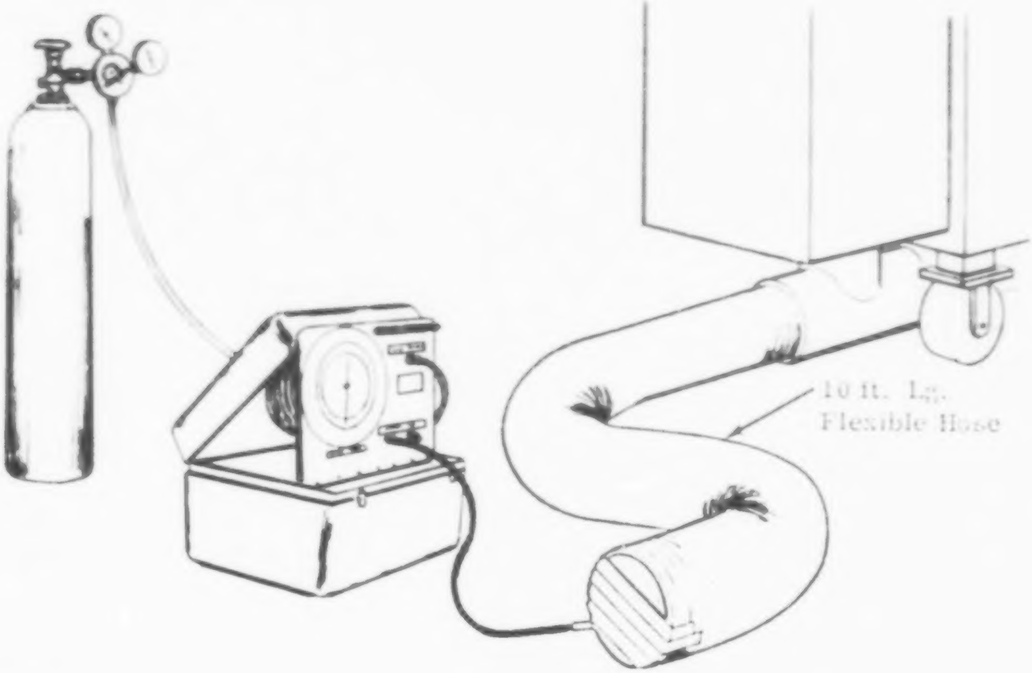
7.2.1 Connect the injection fitting to the dilution box so that the gas is injected into the dilution air stream.

7.2.2 Couple the injection fitting to the CFO apparatus.

7.2.3 Attach the thermometer in the area of the CFO temperature stabilizing coil.

7.2.4 Lock the Hiese gauge in vertical position on the CFO and set the pointer to zero.

7.2.5 Run the CVS for 3 minutes and allow the flow rate and temperature to stabilize.



CFO INJECTION SET-UP

7.2.6 Follow steps in 7.1.3.

7.2.7 Connect the CFO to the gas supply cylinder (CO or propane), open the valves and adjust the regulator to approximately 70 psig for propane and 50 psig for carbon monoxide.

## 8.0 TEST PROCEDURES

Two methods of CVS system verification are presently in use. Section I describes the steps for the Bomb method and Section II outlines the CFO technique.

### SECTION I "THE BOMB"

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Weigh the bomb and record initial weight on data sheet. | gms |
| 102 | Sample the dilute mixture in the normal manner (procedure #707). | |
| 103 | Connect the bomb to the injection probe and open the bomb valve. Regulate the flow rate to 2.0 ±.25 cfh for propane or 12.0 ±.25 cfh for CO. | |
| 104 | While gas is being sampled, check and record the following: | |
| | o Pump inlet pressure. | $P_{in}$ "fluid |
| | o Pump outlet pressure. | $P_{out}$ "fluid |
| | o Barometric pressure. | $P_B$ "Hg |
| | o Ambient room temperature. | $T_{wb}/T_{db}$ °F |
| | o CVS pump inlet temperature. | $T_{in}$ °F |
| 105 | After the tracer gas has been sampled for 15 minutes, close the bomb valve, purge the injection fitting with nitrogen and disconnect from the injection fitting. | |
| 106 | Stop sampling the dilute mixture. Record the pump revolutions and sample time. | Revs<br>t, secs. |
| 107 | Analyze the sample and background bags. Record their concentrations on the data sheet. | $Conc_b$, ppm<br>$Conc_s$, ppm |
| 108 | Have the bomb reweighed and record final weight to the nearest milligram. | gms |

## SECTION II CFO TECHNIQUE

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 201 | When CFO pressure gauge has stabilized, begin sampling the dilute mixture and background air. | |
| 202 | Monitor and record the CFO temperature and pressure several times during the sample period.<br>NOTE: If the pressures and temperatures have not varied more than 0.3 psi and 0.5 °F, record the average. If the variation is greater perform an additional CFO injection. | $T_c$ °F<br>$P_G$ psi |
| 203 | While the gas is being sampled, check and record the following: | |
| | o Pump inlet pressure | $P_{in}$ "fluid |
| | o Pump outlet pressure | $P_{out}$ "fluid |
| | o Barometric pressure | $P_b$ "Hg |
| | o Ambient room temperature | $T_{wb}/T_{db}$ °F |
| | o CVS pump inlet temperature | $T_{in}$ °F |
| 204 | After 10 minutes, stop the sampling mode. Record the revolutions and sample time. | revs<br>t, secs. |
| 205 | Shut off the CFO gas supply cylinder. | |
| 206 | Analyze the sample and background bags. Record the concentration values on the data sheet. | $Conc_b$, ppm<br>$Conc_s$, ppm |

9.0 DATA INPUT

9.1 Check and assure all data has been properly entered on data sheet 301-01.

9.2 Submit data to Data Branch for computer analysis (SAQF: CALIBCK).

## 10.0 DATA ANALYSIS

10.1 Analysis of the "bomb" method is accomplished by the SAQF: CALIBCK computer program. This program compares the indicated mass of the tracer gas versus the actual mass determined by gravimetric difference.

10.2 Analysis of the CFO technique is also performed by the SAQF: CALIBCK program. The observed concentration is compared to the calculated concentration to determine the accuracy (% error) of the system.

## 11.0 DATA OUTPUT

11.1 A computer print-out indicating percent error of the system.

11.2 The results are stored in a computer file for future reference.

## 12.0 ACCEPTANCE CRITERIA

12.1 The acceptable error band for CVS system verification checks is ±2 percent.

## 13.0 QUALITY PROVISIONS

13.1 The results of the tests should be kept on file with Quality Control and analyzed statistically to determine average error/variation.

13.2 If the results of any test exceed the prescribed error band, corrective action should be initiated and the procedure repeated.

13.3 If three consecutive tests are not within the error band, the CVS shall be removed from line operation and recalibrated.

13.4 The Quality Assurance section should suggest possible cause of error by referencing the following troubleshooting guideline.

Positive Error (Indication is higher than true value)

1. Calculated $V_o$ is greater than actual $V_o$.

    a. Original calibration in error.

2. Pump inlet temperature recorder is reading low. A 6°F discrepancy over the test period will give a 1% error.

3. Pump inlet indicator is reading high. A 3.5 in. $H_2O$ high reading will give 1% error.

4. Background concentration reading is too low. Check analyzer zero. Check leakage at floor inlet.

5. Analyzer is reading high. Check span.

6. Barometer reading is in error (too high). Barometric pressure reading should be gravity and temperature corrected.

7. Revolution counter is reading high. (Check pump speed and counters.

8. Mixture is stratified causing the sample to be higher than the average concentration in the mixture.

Negative Error (Indication is lower than true value)

1. Calculated $V_o$ is less than actual $V_o$.

    a. Original calibration in error.

    b. Pump clearances decreased due to influx of some surface adherent material.

2. Pump inlet temperature recorder is reading high.

3. Pump inlet pressure indicator is reading low.

4. Background concentration reading is too high.

5. Analyzer is reading low.

6. Barometer reading is in error (too low).

7. Revolution counter is reading low.

8. There is a leak into the sampling system. Pressure check the lines and fittings on the intake side of sample transfer pumps on both the CVS and analyzer console.

## CVS SYSTEM VERIFICATION BY TRACER GAS INJECTION - TEST DATA SHEET

|  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  | BOMB WEIGHTS (GMS) |  |  |  |
|  |  |  |  |  |  | HC |  | CO |  |
| PREVIOUS CVS TEST NO. | CVS NO. | ANALYZER TRAIN NO. | DATE | COMMENTS | CVS HOURS | INITIAL | FINAL | INITIAL | FINAL |
| - |  |  | / / |  |  |  |  |  |  |

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMBIENT |  |  | CVS PUMP |  |  |  |  |  |  | ANALYZER |  |  |  |  |  |  |  | CFO |  |
|  |  |  |  |  |  | MANOMETER |  |  |  | HC |  |  |  | CO |  |  |  |  |  |
| BARO ("HG) | $T_{DB}$ (°F) | $T_{WB}$ (°F) | $T_{IN}$ (°F) | $P_{IN}$ * | $P_{OUT}$ * | FLUID SP.GR. | UNITS | COUNTS (REVS) | TIME (SECS) | RANGE | BKGD | RANGE | SAMP | RANGE | BKGD | RANGE | SAMP | $T_C$ (°F) | $P_G$ (PSI) |
| 96 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

*NOTE: Specify the column height, units, and fluid specific gravity shown on the manometer.

Form 301-01

TP-301
Attachment No. 1

```
                  CVS SYSTEM VERIFICATION BY TRACER GAS INJECTION
                  -----------------------------------------------

PREV.CVS  CVS  ANALYZER  TEST      CVS           AMBIENT CONDITIONS
TEST NO.  UNIT  TRAIN    DATE     HOURS  BAROMETER  DRY BULB  WET BULB
 0-   0   12C    19     3-31-75  1196.5    28.96      72.8      58.1

COMMENTS: PROPANE INJECTION       RAAB

                              **** CVS PUMP ****

        PRESSURE                                   RPM
TEMP    IN     OUT   COUNTS  SECONDS     RPM     RATIO     CFR       SCFM
102.7  28.75  15.35   8101.   333.2    1458.8   0.9994   0.28295   326.89

     MANOMETER SPECIFICATIONS: IN OF  1.75 SPECIFIC GRAVITY FLUID

                              **** ANALYZER ****

                                                                 CALCULATED
       METER READING    RANGE       CONCENTRATION (PPM)             MASS
 GAS   SAMPLE  BACKGND   S B    SAMPLE   BACKGND  CORRECTED       (GRAMS)
 HC     84.8     0.9     4 4    254.40     2.70    251.70           8.023

                                 **** CFO ****

             ORIFICE PRESSURE                  CONCENTRATION
 GAS   TEMP   PSIG     PSIA          SCFM           (PPM)           % ERROR
 HC    74.5   73.40    87.63       .0275395        252.74           -0.412
```

| EPA TEST PROCEDURE | Number<br>TP-302 | Page 1 of 6 |
|---|---|---|

SUBJECT

DYNAMOMETER CALIBRATION VERIFICATION

| | |
|---|---|
| Reference<br>EPA, ANN ARBOR, MAINTENANCE MANUAL | Data Form No.<br>302-01 |
| Responsible Organization<br>CORRELATION/MAINTENANCE | Computer Program<br>DYNOCK:SAQE |
| Test Witness/REVIEW<br>CORR. AND MAINT. LEADER, QUALITY ASSURANCE | Performance Interval<br>WEEKLY |
| Type of Test Report<br>COMPUTER PRINT-OUT | Supersedes<br>NEW |
| Report Distribution<br>QUALITY ASSURANCE/TEST OPERATIONS/CORRELATION AND MAINT. | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| PROGRAM MGMT | QUALITY ASSURANCE | | |
| LAB. BRANCH | TEST OPERATIONS CHIEF | | |
| LAB. BRANCH | SUPP. SERVICES CHIEF | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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## 1.0 PURPOSE

To verify the dynamometer calibration by a "short-cut method of periodic checks used for the determination of actual power absorption.

## 2.0 TEST ARTICLE DESCRIPTION

2.1 A chassis dynamometer, having the capabilities described in the Federal Register, Part 85, Section 85.075-15.

2.2 Associated speed and horsepower meters.

## 3.0 REFERENCES

3.1 Federal Register, Vol. 38, No. 124, June 28, 1973, 85.075-15.

3.2 EPA, Ann Arbor, Preventive Maintenance Guidelines, Section III.

3.3 Clayton Manual for ECE-50 chassis dynamometer, p. 3-4.

## 4.0 REQUIRED EQUIPMENT

4.1 Light weight test vehicle.

4.2 Tachometer generator assembly.

4.3 Strip chart recorder, Varian 614A.

4.4 Stop watch or electronic timing device.

## 5.0 PRECAUTIONS

5.1 Inflate tires to 45 psi to protect against overheating and wear.

5.2 Align vehicle on dynamometer.

5.3 Position vehicle cooling fan within 12 inches of vehicle radiator to prevent overheating.

5.4 Insure vehicle exhaust is properly vented.

5.5 Restrain vehicle with tie-down and safety chocks.

## 6.0 VISUAL INSPECTION

6.1 Check equipment set-up.

## 7.0 TEST ARTICLE PREPARATION

7.1 Check the speed and power meters for proper calibration. (See procedure #202).

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7.2 Install tachometer generator on the dynamometer frame. Line up the tach generator pulley with the shaft adaptor pulley. Insure that the center to center pulley distance is the same as the factory installed tach generator.

7.3 Attach front roll tachometer generator electrical leads to the Varian chart recorder.

7.4 Place the vehicle on the dynamometer and attach the vehicle restraint system. (Winch and cable).

7.5 Disengage the roll brake.

7.6 Adjust recorder zero.

## 8.0 TEST PROCEDURES

The following steps outline the short-cut coast down method for verifying the dynamometer calibration.

| TEST SEQUENCE | TEST DESCRIPTION | DATA OUTPUT |
|---|---|---|
| 101 | Accelerate vehicle to 60 mph and hold steady. Calibrate the chart recorder at 60 mph full scale. | |
| 102 | Check the calibration of chart at 55, 50, and 45 mph. Insure that the 55 and 45 mph points are easily identified. | 55 = ___divs.<br>45 = ___divs. |
| 103 | Bring the vehicle to a complete stop. Re-zero the recorder and set dyno inertia to 4000 lbs. | |
| 104 | Measure the recorder chart speed with a stopwatch or other timing mechanism. This should be repeated at least 3 times for an accurate measurement of the distance the paper travels in one (1) minute.<br>NOTE: Alternate method of measuring elapsed time: Direct measurement of time elapsed between 55 mph and 45 mph can be accomplished by starting electronic timer at 55 mph and stopping at 45 mph. This method will eliminate interpolation of chart method. | Chart Speed (inches/mins) |
| 105 | Operate the vehicle at a steady 50 mph and set Hp to indicated setting needed for actual power absorption of 12.0 Hp. | |
| 106 | Increase the vehicle speed to 60 mph and use rear cable winch to pull vehicle off the front drive roll. Release accelerator and allow vehicle to slow down. | |

| REVISIONS: | DYNAMOMETER CALIBRATION VERIFICATION<br>**TEST PROCEDURE** | PROCEDURE NO.<br>TP-302<br>PAGE 5 OF 6 |
|---|---|---|

| TEST SEQUENCE | TEST DESCRIPTION | DATA OUTPUT |
|---|---|---|
| 107 | Measure the time for the roll to slow from 55 MPH to 45 mph. Record time. | t, secs. |
| 108 | Bring vehicle speed as indicated on speed meter to within ±5 mph of the front roll speed and slowly loosen winch to allow the drive tires to contact the front roll. | |
| 109 | Repeat steps 106-108 two additional times and record. | t, secs. |

## 9.0 DATA INPUT

9.1 Complete data form 302-01 and submit it for analysis.

## 10.0 DATA ANALYSIS

10.1 Analyze the data using the DYNOCK:SAQE program.

## 11.0 DATA OUTPUT

11.1 Data sheet showing roll down times, signed by responsible technician.

## 12.0 ACCEPTANCE LIMITS

12.1 The average time for coastdowns should be within 1 second. (calculated)

## 13.0 QUALITY PROVISIONS

13.1 If coastdown times are outside of the prescribed limits corrective action and a complete re-calibration will be instituted.

# COASTDOWN CHECK FOR CLAYTON DYNO

DATE________________ DYNO # ________________

| INERTIA WEIGHT | HORSEPOWER SET | ACT. COASTDOWN TIME IN SEC. | CALC. COASTDOWN TIME IN SEC. | DIFFERENCE IN SEC. |
|---|---|---|---|---|
| 2000 | | | 14.63 | |
| 3000 | | | 17.68 | |
| 4000 | | | 20.24 | |
| 5000 | | | 22.66 | |
| 5500 | | | 24.02 | |
| | | | | |

FORM 302-01

Signature________________

| | | |
|---|---|---|
| **EPA TEST PROCEDURE** | Number<br>TP-303 | Page 1 of 5 |

SUBJECT

$NO_x$ Efficiency Check

| | |
|---|---|
| Reference Federal Register, Vol. 39, No. 101,<br>May 23, 1974 - Sec: 85.075-23 | Data Form No.<br>303-01 |
| Responsible Organization<br>Correlation/Maintenance | Computer Program<br>NOXCK:SAQE |
| Test Witness/Review<br>Corr. and Maint. Leader, Quality Assurance | Performance Interval<br>Weekly; Monthly |
| Type of Test Report<br>Computer Print-out | Supersedes<br>New |
| Report Distribution<br>Quality Assurance, Test Operations, Correlation and Maint. | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab. Branch | Chief | | |
| Lab. Branch | Test Operations Chief | | |
| Lab. Branch | Supp. Services Chief | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

1.0 PURPOSE

To determine the conversion efficiency of the $NO_x$ converter which is used to convert $NO_x$ to NO.

2.0 TEST ARTICLE DESCRIPTION

2.1 Chemiluminescent analyzer with a converter capable of transforming nitrogen dioxide to nitric oxide. The nitric oxide is mixed with ozone to form an excited state of nitrogen dioxide which emits light. The light energy emitted is then sensed by a photomultiplier tube into an electric current that is nearly proportional to the amount of nitric oxide present in the sample.

- Thermo Electron (TECO) Model 10A

3.0 REFERENCES

3.1 Federal Register, Vol. 39, No. 101, - May 23, 1974. 85.075-23.

3.2 EPA, Ann Arbor, Preventive Maintenance Guidelines, Appendix B.

3.3 Matheson Gas Book, "Nitric Oxide Handling Provisions"

4.0 REQUIRED EQUIPMENT

4.1 $NO_x$ Converter Efficiency Detector (see Figure 4-1).

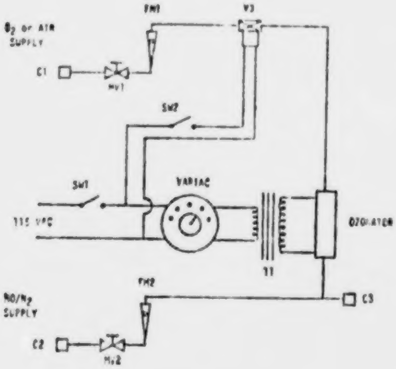

Figure 4-1. $NO_x$ CONVERTER EFFICIENCY DETECTOR

4.2 $NO/N_2$ gas supply, 150 to 250 ppm.

4.3 O2 or air supply.

5.0 PRECAUTIONS

5.1 Nitrogen Oxides are TOXIC gases. Precautions should be taken to insure a safe testing environment is maintained.

5.2 Ozonator should not be pressurized above 10 psig.

6.0 VISUAL INSPECTION

6.1 Insure the test equipment set up is correct. (see diagram 4.1)

6.2 Check $NO/N_2$ and $O_2$ regulator settings @ 10 psig.

7.0 TEST ARTICLE PREPARATION

See Figure 4-1 for preparation clarification.

7.1 Connect the $NO/N_2$ supply at fitting C2.

7.2 Connect the $O_2$ or air supply at fitting C1.

7.3 Attach the analyzer inlet connection to the efficiency detector at C3.

NOTE: Better response is obtained if detector is plumbed to the normal span gas connection, rather than the bag connection.

8.0 TEST PROCEDURE

The following steps are to be performed to assure an accurate check of the converter efficiency.

| Test Sequence | Test Description | Data output |
|---|---|---|
| 101 | With the efficiency detector variac in the off position, place the $NO_x$ converter in the bypass mode and close valve V3. | |
| 102 | Open valve MV2 until stable flow and readings are indicated at the analyzer. | |
| 103 | Zero the analyzer and set span output to indicate the NO concentration being used. Record the concentration. | Conc., ppm (1) |
| 104 | Open the $O_2$ flow control valve (V3) and adjust the $O_2$ metering valve (MV1) to lower the NO concentration by 10 percent. Record the concentration. | Conc., ppm (2) |
| 105 | Turn on the ozonator and slowly increase its voltage until the NO concentration is reduced to roughly 20 percent of the reading in step 103. Record this concentration. | Conc., ppm (3) |
| 106 | When a stable reading is obtained from Step 105, place the $NO_x$ converter in the convert mode. The analyzer will indicate the total $NO_x$ concentration. Record the concentration. | Conc., ppm (4) |
| 107 | Turn off the ozonator and allow the analyzer reading to stabilize. This reading is the $NO_x$ concentration of the dilute span gas. Record concentration. | Conc., ppm (5) |
| 108 | Close valve V3. The NO concentration should be equal to or greater than the reading in Step 103 indicating if the $NO/N_2$mixture contains $NO_2$. | Conc., ppm (6) |
| 109 | If values do not appear to be stable or consistent, repeat the sequence two or more times. | |
| 110 | Disconnect the detector and restore the analyzer to normal operating condition. | |

## 9.0 DATA INPUT

9.1 Check data sheet for complete and reasonable data.

9.2 Submit data form # 303-01 for analysis

## 10.0 DATA ANALYSIS

10.1 Analysis of the converter efficiency is accomplished by the NOXCK:SAQE computer program.

10.2 The efficiency is calculated by substituting the concentrations obtained during the test into the following equation as a quick check prior to computer analysis.

$$\%\ \text{Eff.} = \left[1 + \frac{(a-b)}{(c-d)}\right] \times 100$$

Where:
a = Conc. of Step 106
b = Conc. of Step 107
c = Conc. of Step 104
d = Conc. of Step 105

## 11.0 DATA OUTPUT

11.1 Data format with calculation of the percentage efficiency of $NO_x$ converter.

## 12.0 ACCEPTANCE CRITERIA

12.1 The efficiency of the converter should be above 90 percent.

## 13.0 QUALITY PROVISIONS

13.1 If the efficiency of the converter is less than 90 percent, the Q.A. department should immediately determine the probable cause for the failure.

13.2 The complete procedure should be repeated with a new converter temperature setting.

## NO$_x$ CONVERTER EFFICIENCY DETERMINATION - TEST DATA SHEET

| PREVIOUS TEST NO. | DATE | ANALYZER [illegible] | ANALYZER VENDOR | FULL SCALE RANGE (PPM) | (NO$_x$) CYL. CONC. (PPM) | OPR. INIT. | BARO ("HG) | CONV. TEMP. (°C) | BYPASS FLOW RATE (SCFH) | GAIN SETTINGS ZERO | GAIN SETTINGS SPAN | OZONE PRESS (PSIG) | SAMP. VAC. ("HG) | REACT. PRESS. (TORR) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| - | - - | | | | | | | | | | | | | |

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

| RUN NO. | TEST SEQUENCE . ALYZER READINGS (1) | (2) | (3) | (4) | (5) | (6) | VARIAC SET POINT | COMMENTS: |
|---|---|---|---|---|---|---|---|---|
| 01 | | | | | | | | |
| 02 | | | | | | | | |
| 03 | | | | | | | | |

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

TEST SEQUENCE CODES:

(1) FLOW NO/N$_2$, OZONATOR OFF, CONVERTER BYPASSED

(2) FLOW NO/N$_2$ + O$_2$, OZONATOR OFF, CONVERTER BYPASSED (80% OF (1))

(3) OZONATOR ON, ADJUST TO GET ABOUT 10% OF (1), CONVERTER BYPASSED

(4) SWITCH TO CONVERTER MODE

(5) OZONATOR OFF, CONVERTER MODE

(6) O$_2$ OFF, OZONATOR OFF, CONVERT MODE (6) SHOULD BE GREATER THAN OR EQUAL TO (1).

08-01-73 CDP [redacted].

NOXCK : SAQE

form 303-01

**EPA TEST PROCEDURE**

Number TP-304

Page 1 of 5

SUBJECT

CARBON DIOXIDE AND WATER INTERFERENCE CHECK FOR THE NDIR CARBON MONOXIDE ANALYZER

Reference FEDERAL REGISTER, VOL 38, November 15, 1973, 85.075-23, (a)(7)(iii)

Data Form No. 304-01

Responsible Organization CORRELATION AND MAINTENANCE

Computer Program NONE

Test Witness/Review TEAM LEADER, QUALITY ASSURANCE

Performance Interval See Below

Type of Test Report INITIAL EQUIPMENT CHECKOUT OR WEEKLY CHECK

Supersedes New

Report Distribution QUALITY ASSURANCE, CORRELATION AND MAINTENANCE, TEST OPERATION

Superseded by

REMARKS/COMMENTS

1. If the CO-NDIR meets the requirements of 85.075-20 (C)(11) without the conditioning columns the test is performed to demonstrate conformance to the criteria when the instrument is first put into service.

2. If the instrument does not meet the above criteria conditioning columns must be used and checked weekly or as determined by average column life.

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Test Operations Chief | | |
| Lab Branch | Support Oper Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

**REVISIONS:**

$CO_2/H_2O$ INTERFERENCE CHECK
NDIR-CO

**TEST PROCEDURE**

**PROCEDURE NO.** TP-304
**PAGE** 2 **OF** 5

## 1.0 PURPOSE

To establish conformance with the interference requirements of 85.075-20(c)(11) with new instrument trains or to assure the proper operation of those trains requiring conditioning columns for removal of $CO_2$ and water vapor.

## 2.0 TEST ARTICLE DESCRIPTION

The carbon monoxide analyzers are of the non-dispersive infrared type. Certain instruments available from vendors employ an internal optical filtering mechanism to eliminate the interference from $CO_2$ and water vapor.

Instruments that are not free of interference must use sample conditioning columns consisting of calcium sulfate or indicating silica gel to remove water vapor and ascarite to remove carbon dioxide.

## 3.0 REFERENCES

3.1 *Federal Register*, Vol. 38, Nov 15, 1973 85.075-23(a)(7)(iii)
*Federal Register*, Vol. 39, No. 101, May 23,1974 85.075-20(c)(11)

## 4.0 REQUIRED EQUIPMENT

4.1 Gas bubbler, sized for the flow rate used for the interference check.

4.2 Calibration gas, 3 percent carbon dioxide in nitrogen. Make tolerance on the blend should be within ±5% and the analysis for $CO_2$ ±2%. When ordering this blend the concentration of the CO impurity should be requested not to exceed 1 ppm and/or determined by receiving inspection.

4.3 Zero Air

4.4 Zero Nitrogen

4.5 A portable manifold with selector valves for introducing the above gases individually, wet and dry.

4.6 A hopcolite filter for removing CO from the zero air to establish a true instrument zero.

## 5.0 PRECAUTIONS

5.1 If a glass bubbler is used it should not be subjected to pressure above 2 PSI.

5.2 The bubbler should be contained or shielded to protect the operator in case of explosion (i.e., overpressurization or sudden surge in the glass bubbler).

5.3 Flow rates are important and should be closely controlled.

5.4 Extreme care should be taken not to introduce any water droplets or aerosol into the train or analyzer.

5.5 Leak check the manifold before each use by turning off each cylinder valve and observing any drop in regulator pressure.

6.0 VISUAL INSPECTION

6.1 Check ascarite and silica gel columns for color change, contamination, and clogging, etc., indicating need for replacement.

6.2 Check water level of the bubbler.

7.0 TEST ARTICLE PREPARATION

7.1 The CO analyzer should be on for at least 2 hours prior to test.

## 8.0 TEST PROCEDURE

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Zero instrument using zero air passed through the hopcolite to remove the CO using normal train flow rate and pressure. | Zero |
| 102 | Pass zero nitrogen through instrument to establish nitrogen zero. Use this reading for all subsequent nitrogen zeros. | Zero & CO Impurity |
| 103 | Span instrument on lowest range using same flow rate as zero flow rate. | Span Deflection |
| 104 | Repeat nitrogen zero and span until stability is reached. | Span Deflection |
| 105 | Pass zero nitrogen through water bubbler and analyzer at same flow rate. | Water vapor deflection minus $N_2$ zero |
| 106 | Bypass water bubbler and repeat nitrogen zero | Zero & CO Impurity |
| 107 | Bypass water bubbler and introduce 3% $CO_2$ gas into instrument.<br>NOTE: If CO impurity in the $CO_2$ gas is less that in the nitrogen the reading may be less than the nitrogen zero deflection. | Dry $CO_2$ deflection |
| 108 | Repeat nitrogen zero. | |
| 109 | Pass 3% $CO_2$ thru water bubbler into instrument at same flow rate as the other gases | Wet $CO_2$ Deflection |
| 110 | Repeat nitrogen zero. | |
| 111 | Disconnect manifold, turn off cylinders, relieve regulator pressures. | |

9.0 DATA INPUT

9.1 Complete form #304-01

10.0 DATA ANALYSIS

10.1 Instrument response comparison.

11.0 DATA OUTPUT

11.1 Interference levels for $CO_2$ and $H_2O$ vapor.

12.0 ACCEPTANCE CRITERIA

12.1 The wet $CO_2$ reading on any range above 300 ppm must be less than 1% of full scale; on ranges below 300 ppm the interference must be less than 3 ppm.

13.0 QUALITY PROVISIONS

13.1 If the instrument does not meet acceptance criteria initiate corrective action.

13.2 Repeat the procedure to assure corrective action was successful.

# $CO_2/H_2O$ INTERFERENCE CHECK

Analyzer Model __________ Serial # __________

Date ____________________ Time ______________

1. ☐ Zero Instrument
2. _____________ Nitrogen zero set point
3. _____________ Span deflection (repeat 2 times)
4. _____________ $H_2O$ vapor deflection
5. ☐ Nitrogen zero (bypass bubbler)
6. _____________ Dry $CO_2$ deflection
7. _____________ Wet $CO_2$ deflection

Operator signature _______________________

Form 304-01

# Section 400

# CORRELATION

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# EPA TEST PROCEDURE

| | |
|---|---|
| Number<br>TP-401 | Page 1 of 4 |

SUBJECT

ANALYZER CROSSCHECK

| | |
|---|---|
| Reference EPA, ANN ARBOR, "PREVENTIVE MAINTENANCE GUIDELINES." | Data Form No.<br>401-01 |
| Responsible Organization<br>CORRELATION/MAINTENANCE | Computer Program |
| Test Witness /Review CORRELATION/MAINTENANCE LEADER, QUALITY ASSURANCE | Performance Interval<br>DAILY |
| Type of Test Report | Supersedes<br>NEW |
| Report Distribution<br>QUALITY ASSURANCE, TEST OPERATIONS, CORRELATION & MAINTENANCE | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Chief | | |
| Lab Branch | Test Operations Chief | | |
| Lab Branch | Support Services Chief | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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| **REVISIONS:** | ANALYZER CROSSCHECK<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-401<br>**PAGE** 2 **OF** 4 |
|---|---|---|

1.0 PURPOSE

To assure the correlation of multiple analyzer trains used for exhaust sample analysis.

2.0 TEST ARTICLE DESCRIPTION

2.1 Gas Analysis System equipped with the following analyzers

2.1.1 Hydrocarbon - flame ionization

2.1.2 Carbon monoxide - non-dispersive infrared

2.1.3 Carbon dioxide - non-dispersive infrared

2.1.4 Oxides of Nitrogen - Chemiluminescence

3.0 REFERENCES

3.1 EPA, Ann Arbor, "Preventive Maintenance Guidelines"

4.0 REQUIRED EQUIPMENT

4.1 Composite bag sample collected from a non-test vehicle or an artificial blend from span gases.

5.0 PRECAUTIONS

5.1 Sample bag should be leak checked.

5.1.1 (Short method) Fill the bags with background air and draw through the sample system. If flow indication drops to zero the bags are good, if not replace bag.

6.0 VISUAL INSPECTION

6.1 Check flow and pressure settings prior to and during bag analysis.

7.0 TEST ARTICLE PREPARATION

7.1 Perform daily start-up on each system to be checked.

7.2 Zero and span each analyzer prior to analysis.

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## 8.0 TEST PROCEDURE

The analyzer crosscheck is performed in the following manner.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Fill a sample bag with enough composite vehicle exhaust to perform the crosscheck analysis on a minimum of 4 systems. (Approximately 3.0 cubic feet.) | |
| 102 | A representative from Correlation/Maintenance will carry the sample to the first train to be checked. | |
| 103 | The analyzer operator will analyze the collected sample in accordance with the specified analysis procedure (TP-707). | |
| 104 | The C/M rep. will collect the analyzer traces and mark the train number on each trace. | |
| 105 | The sample is taken to the remaining trains and steps 103 and 104 are repeated for each. | |

## 9.0 DATA INPUT

9.1 Data is transcribed onto data sheet #401-01.

9.2 A complete set of analyzer traces are collected from each train, including the sample concentration.

## 10.0 DATA ANALYSIS

10.1 The concentration for each pollutant HC, CO, $CO_2$ and $NO_x$ is computed from the analyzer traces for each train checked by computer program.

10.2 The concentrations from each train are then compared for any results outside of repeatable limits.

## 11.0 DATA OUTPUT

11.1 The average values and percent deviation (if any) of each train.

## 12.0 ACCEPTANCE CRITERIA

12.1 Results from the crosscheck should repeat by ±3 percent between each system checked.

## 13.0 QUALITY PROVISIONS

13.1 If "out of spec" conditions (see 12.1) exist corrective action will be initiated.

FORM NO. 401-01

## ANALYZER CORRELATION DATA SHEET

Date: ____/____/____

Barometer: __________"HG.

| | | ZERO/SPAN DATA | | | | | | CALCULATED CONCENTRATION | | | | % DEVIATION | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Train NO. | Gas Type | Rge. NO. | Conc. | Set Point | Zero Gain | Span Gain | Sample Deflc | HC | CO | $CO_2$ | $NO_x$ | HC | CO | $CO_2$ | $NO_x$ | OPERATOR |
| 9 | HC | | | | — | — | | | | | | | | | | |
| | CO | | | | | | | | | | | | | | | |
| | $CO_2$ | | | | | | | | | | | | | | | |
| | $NO_x$ | | | | — | — | | | | | | | | | | |
| 15 | HC | | | | — | — | | | | | | | | | | |
| | CO | | | | | | | | | | | | | | | |
| | $CO_2$ | | | | | | | | | | | | | | | |
| | $NO_x$ | | | | — | — | | | | | | | | | | |
| 16 | HC | | | | — | — | | | | | | | | | | |
| | CO | | | | | | | | | | | | | | | |
| | $CO_2$ | | | | | | | | | | | | | | | |
| | $NO_x$ | | | | — | — | | | | | | | | | | |
| 19 | HC | | | | — | — | | | | | | | | | | |
| | CO | | | | | | | | | | | | | | | |
| | $CO_2$ | | | | | | | | | | | | | | | |
| | $NO_x$ | | | | — | — | | | | | | | | | | |
| 21 | HC | | | | — | — | | | | | | | | | | |
| | CO | | | | | | | | | | | | | | | |
| | $CO_2$ | | | | | | | | | | | | | | | |
| | $NO_x$ | | | | — | — | | | | | | | | | | |
| | HC | | | | | | | | | | | | | | | |
| | CO | | | | | | | | | | | | | | | |
| | $CO_2$ | | | | | | | | | | | | | | | |
| | $NO_x$ | | | | — | — | | | | | | | | | | |
| AVERAGE VALUES | | | | | | | | | | | | | | | | |

## Section 500

## MAINTENANCE

Currently no procedures are included in this section of the manual. Procedures pertaining to this section must be supplied by the user and may be supplied by the EPA in subsequent revisions.

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## Section 600

## DAILY OPERATION

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| | | |
|---|---|---|
| **EPA TEST PROCEDURE** | Number<br>TP-601 | Page 1 of 4 |

SUBJECT

OPERATION, MAINTENANCE AND INSTRUMENTATION LOG BOOK ENTRY PROCEDURES

| | |
|---|---|
| Reference<br>EPA, ANN ARBOR "PREVENTIVE MAINTENANCE GUIDELINES" LOG BOOK | Data Form No.<br>LOG BOOKS |
| Responsible Organization<br>CORRELATION/MAINTENANCE, TEST OPERATIONS, INSTRUMENT SERVICES | Computer Program<br>NONE |
| Test Witness /REVIEW INST. SERVICES LEADER<br>CORR. & MAINT. LEADER, TESTING, TEAM LEADER | Performance Interval<br>DAILY & WHEN NECESSARY |
| Type of Test Report<br>LOG BOOK ENTRY | Supersedes<br>NEW |
| Report Distribution<br>Q.A., TEST OPERATIONS, CORRELATION MAINT., INST. SERVICES | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| PROGRAM MGMT. | QUALITY ASSURANCE | | |
| LABORATORY BRANCH | CHIEF | | |
| LABORATORY BRANCH | TEST OPERATIONS CHIEF | | |
| LABORATORY BRANCH | SUPPORT SERVICES CHIEF | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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| REVISIONS: | LOG BOOK ENTRY PROCEDURES<br>**TEST PROCEDURE** | PROCEDURE NO. TP-601<br>PAGE 2 OF 4 |
|---|---|---|

## 1.0 PURPOSE

To record all malfunctions, breakdowns and other items related to the CVS, Analysis System, and dynamometers that are pertinent in effecting proper maintenance and repair of each.

## 2.0 TEST ARTICLE DESCRIPTION

2.1 All test and measurement equipment.

## 3.0 REFERENCES

3.1 EPA, Ann Arbor, "Preventive Maintenance Guidelines."

## 4.0 REQUIRED EQUIPMENT

4.1 Log Book.

## 5.0 PRECAUTIONS

5.1 Insure that all entries explain the problems/solutions thoroughly.

## 6.0 VISUAL INSPECTION

6.1 Log book entries will be checked before each weekly and monthly calibration/check-out period.

## 7.0 TEST ARTICLE PREPARATION

None required.

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| REVISIONS: | LOG BOOK ENTRY PROCEDURES<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-601<br>**PAGE** 3 **OF** 4 |
|---|---|---|

## 8.0 TEST PROCEDURE

In order to make clear, concise log book entries the following steps should be followed.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Log the date and time of malfunction or repair and the responsible technician's initial. | Date, time |
| 102 | Identify the system or individual equipment item. | Item |
| 103 | In clear terminology state the problem encountered and repair made. | |
| 104 | If the log entry is a malfunction or maintenance description, log time and date that Correlation/Maintenance or Instrument Services was notified. Also identify the person notified. | |
| 105 | If the entry is a repair item, state all maintenance performed, and the date and time back on line. The initials of the person responsible for the maintenance or corrective action should be shown. | Initials of responsible party |

| REVISIONS: | LOG BOOK ENTRY PROCEDURES<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-601<br>**PAGE** 4 **OF** 4 |
|---|---|---|

## 9.0 DATA INPUT

9.1 Record all pertinent items in the appropriate Log Book.

## 10.0 DATA ANALYSIS

10.1 A malfunctioning item can usually be diagnosed and repaired more efficiently if all aspects of the failure are known.

10.2 Daily readings of pressure and temperature of the CVS should be checked to assure repeatability from day to day.

## 11.0 DATA OUTPUT

11.1 Log Book becomes a permanent record of all malfunctions and repair of equipment.

## 12.0 ACCEPTANCE CRITERIA

N/A

## 13.0 QUALITY PROVISIONS

13.1 Entries shall be checked on an audit basis and data compiled on all malfunctions and repairs.

13.2 Frequency of maintenance actions shall be compiled by checking the Log Books.

13.3 Audits of the Log Book will also indicate typical maintenance/repairs of test and measurement equipment.

# INSTRUMENT SERVICES LOG BOOK

| MAKE | MODEL | SERIAL NO. | DATE CALIBRATED | DATE DUE | TECH. | REMARKS |
|---|---|---|---|---|---|---|
| ESTERLINE | E1124E | 940456 | 8-29-74 | 11-29-74 | D.P | REPLACED INK PAD & PRINT WHEEL |
| " | " | 940757 | 10-11-74 | 1-11-75 | D.P. | 1° LOW PRIOR TO CAL. |
| HONEYWELL | 194E | 5103576E | 12-7-74 | 3-7-75 | J.J | GAIN HIGH PRIOR TO CAL |
| TEX INSTR | 2596-2 | T135701 | 12-9-74 | 3-9-75 | J.J | REPLACED SLIDE WIRE |

TP-601
Attachment No. 2

## ANALYZER LOG

| DATE | INSTRU. TYPE | GAIN | TUNE | MAINTENANCE/REMARKS | OPER. INITIALS |
|---|---|---|---|---|---|
|  |  |  |  |  |  |

TP-601
Attachment No. 3

## CVS OPERATION LOG

| DATE | IN. PRESS. | OUT. PRESS. | CVS HOURS | COUNTS: 505 | 867 | 505 | REMARKS | OPER. INITIALS |
|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  |  |

| EPA TEST PROCEDURE | Number<br>TP-602 | Page 1 of 4 |
|---|---|---|

| | |
|---|---|
| SUBJECT<br>DRIFT/NOISE/GAIN/TUNE CHECKS | |
| Reference<br>SEE SECTION 3.0 | Data Form No.<br>ANALYZER OP LOG BK |
| Responsible Organization<br>CORRELATION/MAINTENANCE, ANALYZER OPERATION | Computer Program<br>NONE |
| Test Witness/Review<br>ANALYZER OPERATOR, TEAM LEADER | Performance Interval<br>DAILY |
| Type of Test Report<br>ANALYZER LOG BOOK ENTRY | Supersedes<br>NEW |
| Report Distribution<br>QUALITY ASSURANCE, CORRELATION AND MAINTENANCE | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Chief | | |
| Lab Branch | Supp Services Chief | | |
| Lab Branch | Test Operations Chief | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

## 1.0 PURPOSE

To perform a daily check of the analyzers and recorders used in the analysis system.

## 2.0 TEST ARTICLE DESCRIPTION

2.1 An analysis system equipped with the following analyzers.

2.1.1 Hydrocarbons - Flame ionization

2.1.2 Carbon monoxide - NDIR (non-dispersive infrared)

2.1.3 Carbon dioxide - NDIR

2.1.4 Oxides of Nitrogen - Chemiluminescence

2.2 Strip chart recorders

## 3.0 REFERENCES

3.1 EPA, Ann Arbor, Training Manual, "Light Duty Certification Procedures"

3.2 EPA, Ann Arbor, "Preventive Maintenance Guidelines"

## 4.0 REQUIRED EQUIPMENT

4.1 "Working" span gases

4.2 Zero air or nitrogen gases

## 5.0 PRECAUTIONS

5.1 If any discrepant conditions are observed the analyzer operator shall not attempt any repair or adjustment. The condition shall be reported to Correlation/Maintenance and/or Instrument Services for investigation and disposition.

## 6.0 VISUAL INSPECTION

See Section 8.0

## 7.0 TEST ARTICLE PREPARATION

7.1 The instruments shall be warmed up to stable operating conditions (as per individual manufacturer's requirements)

## 8.0 TEST PROCEDURE

The following steps are to be accomplished to check the efficiency of the analyzers and recorders.

| Test Sequence | Test Description | Data Input |
|---|---|---|
| 101 | Zero drift is checked in the following manner. | |
| A | o Introduce zero gas into the analyzer | |
| B | o Adjust the analyzer to read zero millivolts and set the chart recorder on zero | |
| C | o Allow zero gas to flow for approximately 5 to 10 min. | |
| D | o From the strip chart determine the difference between the highest and lowest value of the zero trace. | |
| E | o Record difference as C | C |
| 102 | Excessive noise is indicated on the chart recorder by signal spiking.<br>NOTE: Noise may be caused by the recorder or the analyzer, therefore the gain adjustment of the recorder should be checked. | Noise |
| 103 | The gain setting should be checked daily to assure a major shift has not occurred. Record the analyzer gain setting and check reading from following day. Record percent change. | Gain set., % change |
| 103A | If the chart recorder is insensitive or oversensitive to small changes in input signals (0.50% of full scale), record the problem in the log book. | Recorder gain |
| 104 | If a normal operating span point cannot be reached, or a negative read-out is indicated when a span gas is introduced to an analyzer, record out of tune. Document the type of response in the log book. (Instrument Services and/or Correlation will make final decision to the type of problem encountered) | Out of tune |

| **REVISIONS:** | DRIFT/NOISE/GAIN/TUNE CHECKS<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-602<br>**PAGE** 4 **OF** 4 |
|---|---|---|

9.0 DATA INPUT

9.1 Record any drift, noise, gain or tune problems in the Analyzer log book (attachment A).

10.0 DATA ANALYSIS

10.1 Determine if the problem recorded is an analyzer or recorder malfunction by comparing historical readings in the analyzer log book.

10.2 Determine if the problem is of sufficient magnitude to warrant maintenance.

11.0 DATA OUTPUT

11.1 Enter results in the analyzer log and history file.

12.0 ACCEPTANCE CRITERIA

12.1 Drift should not exceed ±1% of full scale

12.2 Noise should not exceed ±1% of full scale

12.3 Shifts in gain settings should not exceed ±1% in any 24 hour period.

12.4 Compare readings to those in the analyzer log.

13.0 QUALITY CONTROL PROVISIONS

13.1 If problem warrants maintenance submit a corrective action request.

13.2 Prepare and maintain control charts for future analysis.

TP-602
Attachment No. 1

## ANALYZER LOG

| DATE | INSTRU. TYPE | GAIN | TUNE | MAINTENANCE/REMARKS | OPER. INITIALS |
|---|---|---|---|---|---|
|  |  |  |  |  |  |

**EPA TEST PROCEDURE**

| | | |
|---|---|---|
| | Number<br>TP-603 | Page 1 of 5 |

SUBJECT

TEST VEHICLE SCHEDULING

| | |
|---|---|
| Reference<br>EPA, ANN ARBOR, PRODUCTION CONTROLLER | Data Form No.<br>603-01 thru 07 |
| Responsible Organization<br>PRODUCTION CONTROL | Computer Program<br>NONE |
| Test Witness /REVIEW<br>TEST REQUESTOR | Performance Interval<br>DAILY |
| Type of Test Report<br>DAILY AND WEEKLY LOG SHEETS | Supersedes<br>NEW |
| Report Distribution<br>REQUESTOR, PRODUCTION CONTROL, LAB SECTION CHIEF | Superseded by |

REMARKS/COMMENTS

1.0 THIS PROCEDURE IS BEING MODIFIED BY EPA IN CONJUNCTION WITH THE NEW DATA PROCESSING ROUTINES.

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| PROGRAM MGMT. | QUALITY ASSURANCE | | |
| LABORATORY BRANCH | CHIEF | | |
| LABORATORY BRANCH | PRODUCTION CONTROLLER | | |
| LABORATORY BRANCH | TEST OPERATIONS CHIEF | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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1.0 PURPOSE

To schedule all vehicle testing to be performed by Testing Operations.

2.0 TEST ARTICLE DESCRIPTION

The vehicle to be tested may be of any type as long as it can be driven on a dynamometer, has an engine displacement of at least 50 cubic inches, meets the Federal Register requirements for a light duty vehicle and meets the criteria of acceptance in test procedure #701.

3.0 REFERENCES

Procedures Manual Section 5.3

4.0 REQUIRED EQUIPMENT

None

5.0 PRECAUTIONS

Does not apply

6.0 VISUAL INSPECTION

None

7.0 TEST ARTICLE PREPARATION

None

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## 8.0 SCHEDULING PROCEDURE

The procedure for scheduling of a vehicle covers the period from the initial request thru the final release of the vehicle from the test area. Scheduling is done on a daily and weekly basis. Testing schedule projections are done on a yearly basis using information on testing requests obtained from Certification and other divisions.

| Test Sequence | Description |
|---|---|
| 101 | All request for tests are sent to Production Control using a form such as 603-04. See Figure 8.1. |
| 102 | Production control schedules the test and sends verification of test time and date to the requestor. For certification tests form #603-03, Job Request, is used. |
| 103 | Production control makes out the test schedule for the week on Thursday and submits the schedule to Testing Operations and the Laboratory Branch Chief using form #603-06. |
| 104 | Confirmation of schedule is returned to Production Control on Friday. |
| 105 | Daily schedules for each test are all submitted to the Light Duty Testing Supervisor on the preceding day using form #603-06. |
| 106 | Weekly schedules are submitted to the Evaluational Development section on the preceding Friday using form #603-07. |
| 107 | The projected scheduling for the Laboratory Branch is revised and submitted to testing operations and the Laboratory Branch Chief on the first of each month. |
| 108 | Production control receives and ships the vehicle after notification of valid test using form #603-01. In addition the shipping and receiving order must be authorized by both the EPA Division Representative and the Manufacturers Representative.<br>In cases where the above authorizations are not available the signature of the Laboratory Branch Chief is required. |
| 109 | If the test for any reason is invalid it is rescheduled at the earliest convenient date. Notification of new time and date is sent to the requestor. |

REVISIONS:

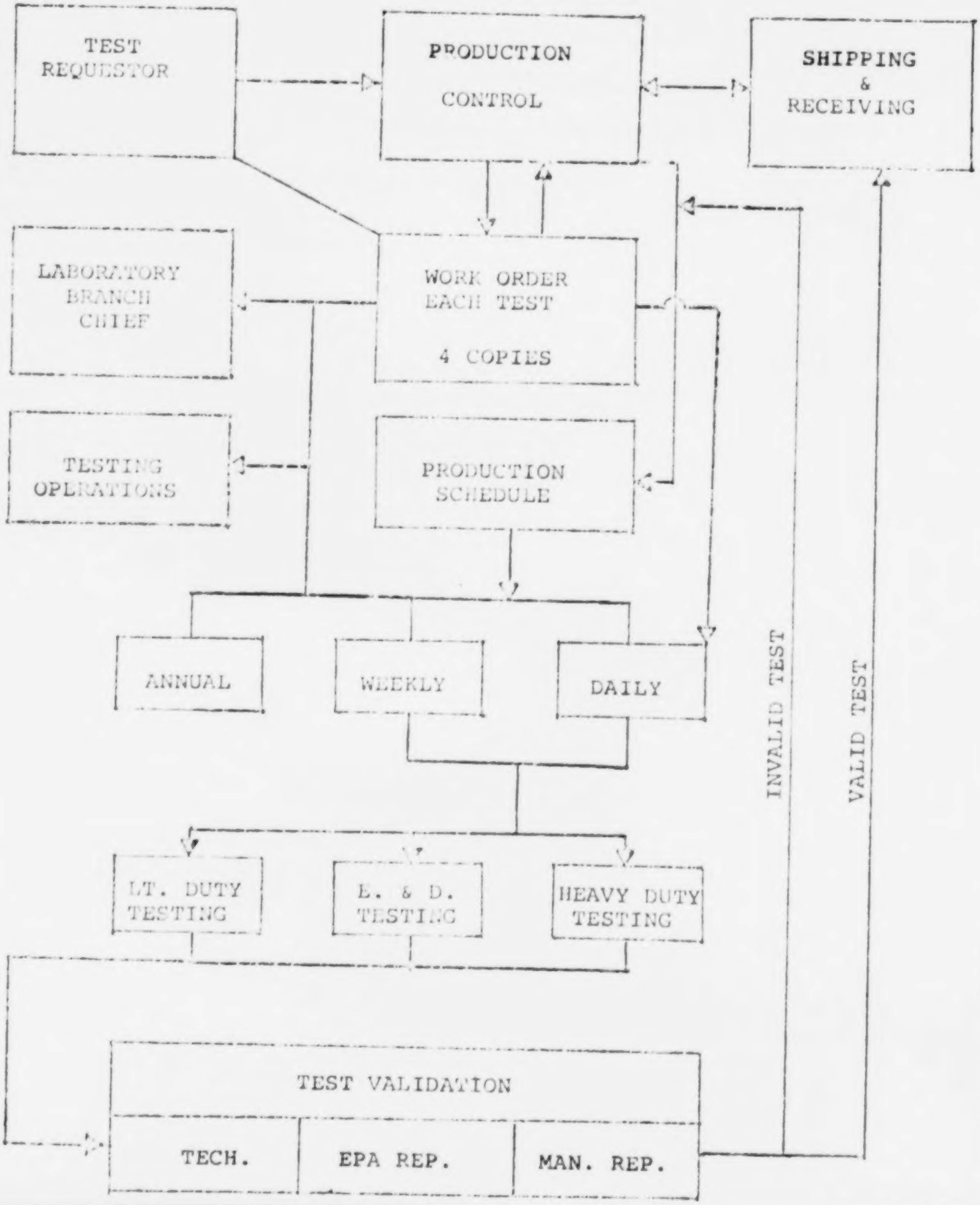
TEST VEHICLE SCHEDULING

**TEST PROCEDURE**

**PROCEDURE NO.** TP-603

**PAGE** 4 **OF** 5

Figure 8.1 Scheduling Procedure


TEST REQUESTOR
PRODUCTION CONTROL
SHIPPING & RECEIVING
LABORATORY BRANCH CHIEF
WORK ORDER EACH TEST 4 COPIES
TESTING OPERATIONS
PRODUCTION SCHEDULE
ANNUAL
WEEKLY
DAILY
INVALID TEST
VALID TEST
LT. DUTY TESTING
E. & D. TESTING
HEAVY DUTY TESTING
TEST VALIDATION
TECH.
EPA REP.
MAN. REP.

## 9.0 DATA INPUT

Does not apply.

## 10.0 DATA ANALYSIS

None

## 11.0 DATA OUTPUT

Does not apply.

## 12.0 ACCEPTANCE CRITERIA

None

## 13.0 QUALITY PROVISIONS

13.1 Forms and procedure reviewed by Quality Assurance Management.

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
2565 Plymouth Road
Ann Arbor, Michigan 48105

## SHIPPING AND RECEIVING ORDER

**Manufacturer** ______________________________

**Identifying No.(s)** ① ________ ② ________ ③ ________

④ ________ ⑤ ________ ⑥ ________ ⑦ ________

⑧ ________ ⑨ ________ ⑩ ________ ⑪ ________

**Description, Special Marks, and Exceptions** ______________________________

☐ **The vehicle/engine(s) described above was/were RECEIVED into custody of this installation on** ________ ________________ 19____ at ________ AM ________ PM.

☐ **The vehicle/engine(s) described above is/are officially RELEASED to the manufacturer or his representative on** ________________ 19____ at ________ AM ________ PM.

______________________________
**EPA Division Representative**
☐ CSD ☐ ECTD ☐ AAPSD

______________________________
**Manufacturer Representative**

______________________________
**Production Control Office**

**Date** ________________ 19____
________ AM ________ PM

______________________________
**Received by**

EPA (XAA-303) 5-74

FORM #603-01

MSPCP(AA) 1-10-73

## LABORATORY BRANCH
## COMPLIANCE TEST REQUEST

Job # ______________

**REQUEST**

Name ______________________________ Date Submitted ______________

Section ______________________ Extension ______________

Test Type: ☐ Data ☐ Correlation ☐ 2nd Retest
☐ Durability ☐ 1st Test Reason: ______________
☐ Running Change ☐ 1st Retest ______________

Test Procedure ______________________________

Special Test(s) Requested ______________________________

Description:

Manufacturer ______________________ L.D. ☐ H.D. ☐

Identification ______________________________

Engine Family ______________________ System ______________

Reference No. ______________________________

Expected Delivery Date ______________________________

Latest Acceptable Completion Date ______________________________

**SCHEDULE**

Prep Date ______________

Test Date ______________

**RESCHEDULED FOR**

Delivery Date ______________

Prep Date ______________

Test Date ______________

Production Controller's Comments: ______________________________

______________________________________________

Job # ______________

Requestor ______________ Section ______________ Ext. ______

**TEST TEAM REPORT**

Date Received ______________ Technician Assigned ______________

Comments ______________________________

**TECHNICIAN REPORT**

Date Began ______________ Time __________ am/pm Man-Hours ______________

Date Complete ______________ Time __________ am/pm

Comments/Problems ______________________________

______________________________________________

______________________________________________

______________________________________________

**TEST VALIDITY**

EPA Rep. ______________________ ☐ Valid ☐ Invalid

Technician ______________________ ☐ Valid ☐ Invalid

Manufacturer's Rep. ______________________ ☐ Valid ☐ Invalid

If invalid, why? ______________________________

______________________________________________

WHITE: REQUESTOR'S COPY
YELLOW: PRODUCTION CONTROLLER'S COPY
PINK: LAB SECTION CHIEF'S COPY
GOLD: REQUESTOR'S IN-PROCESS COPY

FORM #603-02

MSPCP(AA) 1-10-73

## LABORATORY BRANCH
## JOB REQUEST

Job # ____________

### REQUEST

Name ______________________ Date Submitted ____________

Branch ____________ Section ____________ Extension ________

Project Number/Description ______________________

Job Description (Attach sketches needed) ______________________

Special Equipment Required ______________________

Proprietory Item: ☐ Yes ☐ No

Craft Requested ______________________

Date Item To Be Delivered for Test ______________________

Latest Acceptable Completion Date ______________________

### SCHEDULE

Date Request Rec'd ____________

Craft(s)/Team Assigned ____________

Date ________ Time ________ am/pm

### RESCHEDULED FOR

Date ________ Time ________ am/pm

Reason ______________________

Job # ____________

Requestor ____________ Branch ____________ Ext. ________

### CRAFT/TEAM REPORT

#1 ____________

Technician ____________

Date Began ________ Time ________ am/pm

Date Complete ________ Time ________ am/pm

Man-Hours ____________

Comments/Problems ____________

#2 ____________

Technician ____________

Date Began ________ Time ________ am/pm

Date Complete ________ Time ________ am/pm

Man-Hours ____________

Comments/Problems ____________

WHITE: REQUESTOR'S COPY
YELLOW: PRODUCTION CONTROLLER'S COPY
PINK: LAB SECTION CHIEF'S COPY
GOLD: REQUESTOR'S IN-PROCESS COPY

FORM #603-03

ADVANCE TEST PROJECTION REQUEST
DIVISION OF CERTIFICATION AND SURVEILLANCE

| Projection Period | Name | Branch/Section | Extension | Date Submitted |
|---|---|---|---|---|
| | | | | |

| Manufacturer Name | Identification Number | Delivery Date | Test Date | Requirement | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Indicate Year Below ('72, '73, '74, '75, '76, '77, '78, '79, '80) | | | | | | |
| | | | | Emission Data | Correlation | Durability | Surveillance | Running Change | Total | Other (Specify) |
| | | | | A | B | C | D | E | | F |
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FORM #603-04

# LIGHT-DUTY TESTING SCHEDULE

**Period**________________ Date Submitted____________________

| Test Time | Sun. Name/ID | Mon. Name/ID | Tues. Name/ID | Wed. Name/ID | Thurs. Name/ID | Fri. Name/ID | Sat. Name/ID |
|---|---|---|---|---|---|---|---|
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FORM #603-05

ENVIRONMENTAL PROTECTION AGENCY
Office of Air Programs
Ann Arbor, Michigan 48105

Light Duty Testing Schedule for________________ Date Submitted__________

| Test Number | Technician | Manufacturer of Vehicle | Vehicle Identification | Dynamometer No. | Start | Fuel Economy | Type Test | Re-Test | Job Request |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
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FORM #603-06

ENVIRONMENTAL PROTECTION AGENCY

Ann Arbor, Michigan 48105

E & D Testing Schedule for__________________ Date Submitted____________

| TEST NUMBER | TECHNICIAN | MANUFACTURER OF VEHICLE | VEHICLE IDENTIFICATION | DYNAMOMETER No. | START | FUEL ECONOMY | TYPE TEST | RE-TEST | JOB REQUEST |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
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| FORM #603-07 | | | | | | | | | |

| EPA TEST PROCEDURE | Number<br>TP-604 | Page 1 of 4 |
|---|---|---|

SUBJECT

DYNAMOMETER WARM-UP/SET

| | |
|---|---|
| Reference *Federal Register*, Vol. 38, No. 209<br>October 31, 1973, Sec. 85.075-15 | Data Form No.<br>705-01 |
| Responsible Organization<br>Test Operations | Computer Program<br>-- |
| Test Witness/Review<br>Team Leader | Performance Interval<br>Daily |
| Type of Test Report<br>Data Sheet | Supersedes<br>New |
| Report Distribution<br>Q.A., Data Validation, Certification Branch | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mangmt. | Quality Assurance | | |
| Laboratory Branch | Chief | | |
| Laboratory Branch | Test Operations Chief | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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| REVISIONS: | DYNAMOMETER WARM-UP<br>**TEST PROCEDURE** | PROCEDURE NO. TP-604<br>PAGE 2 OF 4 |
|---|---|---|

## 1.0 PURPOSE

To assure the Dynamometer and associated equipment has been conditioned properly. The horsepower/inertia for first vehicle is also set at this time.

## 2.0 TEST ARTICLE DESCRIPTION

2.1 Chassis dynamometer having the capabilities described in Federal Register 85.075-15.

2.2 Associated speed and horsepower (torque) meters.

2.3 Drivers Aid, Varian or Hewlett-Packard.

## 3.0 REFERENCES

3.1 Federal Register, Vol. 38, No. 209 - Oct. 31, 1973 - Sec. 85.075-15

3.2 EPA, Ann Arbor, "Light Duty Test Operations", Draft

## 4.0 REQUIRED EQUIPMENT

4.1 Light-weight non-test vehicle

## 5.0 PRECAUTIONS

5.1 Check carefully to assure that the desired Hp and Inertia is properly set.

5.2 Inflate tires to 45 psi, to protect against blow-outs

5.3 Tie down vehicle with winch cable.

## 6.0 VISUAL INSPECTION

6.1 Check the vehicle alignment on the dynamometer

## 7.0 TEST ARTICLE PREPARATION

7.1 Drive non-test vehicle onto dynamometer

7.2 Check "drivers-aid" for paper, ink and zero calibration

7.3 Position cooling fan within 12 inches of vehicle radiator, to prevent overheating

7.4 Insure vehicle exhaust is properly vented

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| | | |
|---|---|---|
| **REVISIONS:** | DYNAMOMETER WARM-UP<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-604<br>**PAGE** 3 **OF** 4 |

8.0 TEST PROCEDURE

The following steps are to be performed for proper dyno warm-up and horsepower setting.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Prior to the first test of the day, drive warm-up vehicle at 30 mph for 15 minutes | |
| 102 | Stop vehicle, set inertia weight and select horsepower required for next certification vehicle to be tested. Record inertia wt. and Hp. in Section II of form #705-01. | Inertia Wt, lbs. indicated horsepower |
| 103 | Accelerate to 50 mph; using the loading control switch set Hp required for next vehicle (Automatic loading system may be used). | |
| 104 | Hold steady at 50 mph/or 5 minutes. Check calibration of the "drivers-aid" against the speed meter to assure they both indicate 50 mph. If the drivers-aid is out of adjustment contact the Team Leader. | |
| 105 | Stop the warm-up vehicle disconnect exhaust vent system and remove the vehicle from the dynamometer. | |

**REVISIONS:**

DYNAMOMETER WARM-UP

**TEST PROCEDURE**

**PROCEDURE NO.** TP-604

**PAGE** 4 **OF** 4

## 9.0 DATA INPUT

9.1 Complete Section II of data form #705-01.

9.2 Technician will sign and date form when warm-up is complete.

## 10.0 DATA ANALYSIS

None Required

## 11.0 DATA OUTPUT

11.1 Form #705-01 will remain with cert. vehicle until completion of DE-PREP.

## 12.0 ACCEPTANCE CRITERIA

12.1 Correct inertia and horsepower setting must be indicated in Section II of form #705-01.

12.2 Check for signature of Technician, indicating warm-up and horsepower set was performed.

## 13.0 QUALITY CONTROL PROVISIONS

13.1 Any equipment malfunctions (i.e., drivers-aid, dyno, meters) will be reported to Q.A. department by the Team Leader or Test Operations representative and corrective action (maintenance) should be initiated.

## VEHICLE TEST AND EVAPORATIVE DATA

Vehicle Mfgr.______________________________ No.____________________

Inertia Wt.__________ HP__________ A/C_________ Test # ______________

---

### I. HEAT BUILD

| | TECH | CTA |
|---|---|---|
| A. Drain fuel | ☐ | ☐ |
| B. Plumb air cleaner | ☐ | ☐ |
| C. Plumb canister | ☐ | ☐ |
| D. Plumb bowl vent (if required) | ☐ | ☐ |
| E. Trap gas cap (if required) | ☐ | ☐ |
| F. Seal orifices/vents | ☐ | ☐ |
| G. Install carbon traps (record on data sheet) | ☐ | ☐ |
| H. Hook-up temperature recorder | ☐ | ☐ |
| I. Hook-up thermocouple leads | ☐ | ☐ |
| J. Install heat blanket | ☐ | ☐ |
| K. Plug in fuel tank heater (when used) | ☐ | ☐ |
| L. Refuel vehicle - 40% of tank capacity | ☐ | ☐ |

Tech. Sig.____________________ Witness Sig.____________________

M. Replace fuel cap, plug exhaust pipe(s) Unclamp canister ☐ ☐

| Heat Build Progress | Fuel Temp. Lead No. 1 | Fuel Temp. Lead No. 4 | Ambient Temp. |
|---|---|---|---|
| 0-Min. | | | |
| 15-Min. | | | |
| 30-Min. | | | |
| 45-Min. | | | |
| 60-Min. | | | |

---

### II. DYNAMOMETER WARM-UP/SET

A. Drive non-test vehicle onto dyno B. Hook-up vehicle as for Hot LA-
C. Set inertia______lbs.@______H.P. D. Drive @50mph steady state
E. Remove vehicle from dyno

I. Tech. Sig.______________________________ Date______________

II. Tech. Sig.______________________________ Date______________

FORM 705-01

## Section 700

## EMISSION TESTING

|  |  |  |
|---|---|---|
| **EPA TEST PROCEDURE** | Number<br>TP-701 | Page 1 of 4 |

| | |
|---|---|
| SUBJECT<br>TEST VEHICLE INSPECTION AND ACCEPTANCE | |
| Reference EPA Training Manual, "Light Duty Certification Procedures" | Data Form No.<br>701-01 |
| Responsible Organization<br>Production Control | Computer Program<br>None |
| Test Witness/Review<br>Manufacturer's Representative, Certification Rep., Q.A. | Performance Interval<br>See Comments |
| Type of Test Report<br>Data Sheet | Supersedes<br>New |
| Report Distribution<br>Q.A., Data Validation, Certification Branch | Superseded by |

REMARKS/COMMENTS

Each vehicle must be inspected and accepted prior to each emission test.

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mangmt. | Quality Assurance | | |
| Laboratory Branch | Chief | | |
| Laboratory Branch | Test Operation Chief | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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## 1.0 PURPOSE

To determine whether a vehicle is properly prepared and acceptable for emission testing, each vehicle will be inspected prior to vehicle preparation.

## 2.0 TEST ARTICLE DESCRIPTION

Test vehicle meeting manufacturer's and Federal requirements.

## 3.0 REFERENCES

EPA, "LIGHT DUTY CERTIFICATION PROCEDURES," TRAINING MANUAL, APPENDIX

## 4.0 REQUIRED EQUIPMENT

None required

## 5.0 PRECAUTIONS

5.1 If a vehicle being inspected does not have a required device, the team leader should be contacted.

## 6.0 VISUAL INSPECTION

SEE "TEST PROCEDURES."

## 7.0 TEST ARTICLE PREPARATION

7.1 PREPARED BY VEHICLE MANUFACTURER.

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| | | |
|---|---|---|
| **REVISIONS:** | TEST VEHICLE INSPECTION AND ACCEPTANCE<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-701<br>**PAGE** 3 **OF** 4 |

## 8.0 TEST PROCEDURE

The following inspection must be followed for proper vehicle acceptance.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Check vehicle for valid license plate, properly mounted. | OK, NONE |
| 102 | Check for exhaust adaptor | OK, NONE |
| 103 | Is fuel drain connected | OK, NONE |
| 104 | Thermocouple lead hook-up | OK, NONE |
| 105 | Vehicle Damage, note on back of data sheet | OK, NOTE ON BACK |
| 106 | Insure equipment is connected (notify production control if disconnected equipment is found) | |
| 107 | Insure manufacturer's data sheet is clearly posted. | OK, NONE |
| 108 | Check oil level (if low, notify production control) | OK, NONE |
| 109 | Check for minimum 1/4 tank fuel level (add if required). NOTE: See Vehicle Fueling Procedure. | OK, NONE |
| 110 | Check for manufacturer's start-up procedure. | OK |
| 111 | If the above data is complete clear for AMA route. | OK |

| REVISIONS: | TEST VEHICLE INSPECTION AND ACCEPTANCE<br>**TEST PROCEDURE** | PROCEDURE NO. TP-701<br>PAGE 4 OF 4 |
|---|---|---|

9.0 DATA INPUT

9.1 Submit completed Inspection form #701-01 to Data Validation following evaporative testing.

10.0 DATA ANALYSIS

10.1 Insure all required information is complete and correct.

11.0 DATA OUTPUT

11.1 Data form 024-01 submitted to Certification Branch for vehicle file storage.

12.0 ACCEPTANCE CRITERIA

12.1 Vehicle must follow criteria stated in Section I of Driver's Preconditioning form.

13.0 QUALITY CONTROL PROVISION

13.1 If vehicle is not within acceptable limits the manufacturer's representative should be notified prior to "AMA" preconditioning.

13.2 The inspector shall verify all conditions have been satisfied and shall enter his EPA I.D. # on the vehicle test data sheet.

## F.T.P. MINUS EVAP PLUS F.E.T.

## DRIVER'S PRECONDITIONING REPORT

Vehicle mfgr.____________________ No.____________________

Time Out____________ Time In____________ Odom____________

Date____________________ Test#____________________

I. VEHICLE INSPECTION

A. Valid License Plate ☐ OK ☐ None

B. Exhaust Adaptor ☐ OK ☐ None

C. Fuel Drain ☐ OK ☐ None

D. Vehicle Damage (note on reverse) ☐ OK ☐ Note

E. Equip. not connected notify Prod. Cont. ☐ OK ☐ Note

F. Mfgr's Data Sheet ☐ OK ☐ None

G. Oil level; if low notify Prod. Cont. ☐ OK ☐ Note

H. Odom Reading ☐ OK

I. Fuel level, 1/4-tank min,; add if required.

J. Start-up per Mfg. instructions ☐ OK

K. Drive AMA route ☐ OK

II. AMA PRECONDITIONING

| | | | | | |
|---|---|---|---|---|---|
| A. | Engine Start | ☐ Good | | ☐ Hard | ☐ False |
| B. | Ignition Switch | ☐ OK | | ☐ Other | |
| C. | Starter Motor | ☐ OK | | ☐ Grinds | ☐ No Start |
| D. | Fast Idle | ☐ OK | | ☐ None | ☐ Engine Hot |
| E. | Transmission | ☐ OK | | ☐ Shifts Hard | |
| F. | Clutch | ☐ OK | Grabs | ☐ Slips | ☐ N/A |
| G. | Brakes | ☐ OK | Fade | ☐ Poor | ☐ None |
| H. | Driveability | ☐ Surge<br>Engine Miss ☐<br>☐ OK | ☐ Stumble | ☐ Back Fire<br>Diesels ☐ | ☐ Stretchy |

Driver's Signature______________________________

FORM 701-01

| | | |
|---|---|---|
| **EPA TEST PROCEDURE** | Number<br>TP-702 | Page 1 of 7 |

| | |
|---|---|
| SUBJECT<br>EVAPORATIVE EMISSIONS PREPARATORY PROCEDURES | |
| Reference FEDERAL REGISTER, VOL. 38, NO. 209, Oct. 21, 1973<br>85.075-11 & EPA TRAINING MANUAL | Data Form No.<br>701-01 |
| Responsible Organization<br>TEST OPERATIONS | Computer Program<br>NONE |
| Test Witness/Review<br>TEAM LEADER, QUALITY ASSURANCE | Performance Interval<br>PER CERT.VEHICLE |
| Type of Test Report<br>DATA FORM OUT-PUT | Supersedes<br>NEW |
| Report Distribution<br>QUALITY ASSURANCE, DATA VALIDATION, TEST FILE, CSD | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Chief | | |
| Lab Branch | Test Operations Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

| REVISIONS: | EVAPORATIVE EMISSIONS<br>PREPARATORY PROCEDURES<br>**TEST PROCEDURE** | PROCEDURE NO.<br>TP-702<br>PAGE 2 OF 7 |
|---|---|---|

1.0 PURPOSE

To prepare test vehicles for the Diurnal (Heat Build) Evaporative test and the 1975 FTP.

2.0 TEST ARTICLE DESCRIPTION

Test vehicle (see Section 5.0 below)

3.0 REFERENCES

3.1 Federal Register, Vol. 38, No. 209, Oct 21, 1973, Para. 85.075-11

3.2 EPA, "Light Duty Certification Procedures," Training Manual.

4.0 REQUIRED EQUIPMENT

4.1 Engine analyzer which includes:
NOTE: See manufacturer's manual for calibration procedure.

- Timing light
- Tachometer
- Dwell Meter

4.2 CO Analyzer (i.e., Mexa 300, Sun, Snap-On, etc.)
(Calibrate as shown in manufacturer's manual)

4.3 Chassis dynamometer (see procedure #202 for calibration.)

4.4 Varian, "driver's aid" (see procedure #204 for calibration

5.0 PRECAUTIONS

5.1 If the following items are not on the vehicle Do Not Continue Test!

- Vehicle test data sheet
- Marmon coupler
- Evaporative plumbing
- Thermocouples
- Fuel drain

5.2 If the vehicles has to be weighed, lock the scale platform before moving vehicle on or off.

5.3 Use the proper fuel for each vehicle (see procedure #704)

5.4 When driving the "A.M.A." route, insure conditions are safe and do not exceed the speed limit. If road conditions are UNSAFE return to garage by shortest route.

5.5 Do not do any maintenance or adjustments and do not hook up any disconnected devices.

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5.6 If vehicle does not start inform supervisor and manufacturers representative.

5.7 Be sure the "AMA" route has been driven prior to the LA-4.

5.8 If vehicle does not have sufficiently good drivability to follow LA-4 trace, report to the Team Leader.

## 6.0 VISUAL INSPECTION

6.1 Insure basic preliminary data is clearly posted on the vehicle.

6.2 Carefully inspect for disconnected devices.

## 7.0 TEST ARTICLE PREPARATION

7.1 Obtain car keys from the Production Controller.

7.2 Obtain the Preconditioning Driver's Report form #701-01

## 8.0 TEST PROCEDURES

The following steps must be taken to insure the proper preparation of a test vehicle for the 1975 Evaporative Emission and Federal Cycle Test.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Fill out vehicle condition section of form 701-01 (Preconditioning Drivers Report) | Form Requirement |
| 102 | Insure that colored tape is attached to steering wheel/fuel cap and data sheet. (Red or Orange = indolene clear) (green = indolene 30) | -- |
| 103 | Start the vehicle according to manufacturer's procedures. Check the following items on the engine start section of the preconditioning driver's report, with an "x." | |
| | o Satisfactory engine start | Good |
| | o If engine cranks for 10 seconds or more | Hard Start |
| | o If engine starts and then dies/record number of false starts | False Start |
| | o Check seat belt interlock function | |
| 103A | o Ignition switch satisfactory | Okay |
| | o Ignition switch fails | Other |
| 103B | o Starter motor engages properly | Okay |
| | o Starter motor grinds | Grinds |
| | o Starter malfunctions | Other |
| 103C | o Car starts and fast idles without stalling | Okay |
| | o Car starts but does not fast idle | None |
| | o Car has been driven immediately prior to start (fast idle not required) | Engine Hot |
| 104 | Weigh vehicle at designated area. Record on checksheet | Curb Weight |
| 105 | Check for fuel level. If less than 1/4 full, take the vehicle to area designated for fueling (note: check for type of fuel needed by color tape) | -- |
| 105A | If fuel is added record the date, fuel type and amount on "vehicle test fuel record." This must be signed by the technician and a witness. | Date<br>Fuel Type |

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 106 | Drive the "A.M.A." preconditoning route. (See Attachment A to this procedure.) Note departing time on drivers form. | Date/Time |
| 106A | After completing the AMA route, log in time and take the vehicle to the designated prep bay | Date<br>Time |
| 107 | Evaluate drivability. If the vehicle drives well, indicate good on checksheet | Good |
| 107A | If the vehicle does not drive well check "other" and evaluate criteria listed below | Other |
| | Transmisssion | |
| 107B | o Transmission smooth | |
| | o Transmission (manual) difficult to operate | Shifts hard |
| | o Transmission (automatic) jerks between shifts | Shifts hard |
| | Clutch | |
| 107C | o Clutch operates smoothly | Okay |
| | o Clutch grabs, slips or malfunctions | Other |
| | o Automatic transmission indicate "N/A" in other space | N/A |
| | Brakes | |
| 107D | o Brakes function properly | Okay |
| | o Brakes grab, fade, squeal or malfunction | Other |
| 108 | If vehicle pulsates when driven at a constant speed, indicate surge | Surge |
| 108A | If vehicle has a short, sharp reduction in acceleration rate, indicate stumble | Stumble |

| REVISIONS: | EVAPORATIVE EMISSIONS<br>PREPARATORY PROCEDURES<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-702<br>**PAGE** 6 **OF** 7 |
|---|---|---|

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 108B | If the vehicle has a lack of anticipated throttle response, during light/moderate accels, indicate stretchy | Stretchy |
| 108C | If any loud popping noises are detected coming from the tailpipe or carburetor, indicate backfire | Backfire |
| 108D | If the engine continues to run when ignition is turned off, indicate diesel | Diesel |
| 109 | Following the evaluation steps listed above the driver must sign his name to the form | Signature |
| 110 | The following steps must be taken and information recorded on the Vehicle Inspection section of the preconditioning drivers report. | -- |
| 110A | Check the idle CO using an infrared analyzer such as a Mexa 300. Check/adjust the calibration settings. | % CO |
| 110B | Follow the method for checking timing posted on the vehicle data sheet (should be posted in window of vehicle) check the timing and record under "Measured Values." | Degrees before or after TDC |
| 110C | Insure that reading taken is within acceptable tolerance allowed by EPA. If out of tolerance contact supervisor and manufacturers representative | |
| 110D | Record RPM at which timing was taken | RPM |
| 110E | Check idle RPM (use manufacturer's technique) and record. Check tolerance. | RPM |
| 110F | Check and record tire size | Tire Size |
| 110G | Check axle ratio or N/V | |
| 111 | Record date and the technician must sign this form | Date<br>Signature |

## 9.0 DATA INPUT

9.1 Fill in Sections I, II, III on form 701-01

9.2 Turn form into Data Validation section for transfer of information onto CVS data sheet

## 10.0 DATA ANALYSIS

10.1 Data entered into Section III must be analyzed to assure that they are within specified acceptable limits.

## 11.0 DATA OUTPUT

11.1 Section III information becomes part of the final certification results via CVS data form

11.2 Form No.701-01 filed in Data Validation Office.

## 12.0 ACCEPTANCE CRITERIA

12.1 All items must be evaluated. Tolerances: CO to be ±.5% and RPM to be ±150 RPM

## 13.0 QUALITY PROVISIONS

13.1 Institute corrective action if all required data is not filled in.

13.2 Notify Certification Branch representative if out of "specification limits"

## F.T.P. MINUS EVAP PLUS F.E.T.

## DRIVER'S PRECONDITIONING REPORT

Vehicle mfgr. ______________________ No. ______________________

Time Out ______________ Time In ______________ Odom ______________

Date ______________ Test# ______________

### I. VEHICLE INSPECTION

A. Valid License Plate ☐ OK ☐ None

B. Exhaust Adaptor ☐ OK ☐ None

C. Fuel Drain ☐ OK ☐ None

D. Vehicle Damage (note on reverse) ☐ OK ☐ Note

E. Equip. not connected notify Prod. Cont. ☐ OK ☐ Note

F. Mfgr's Data Sheet ☐ OK ☐ None

G. Oil level; if low notify Prod. Cont. ☐ OK ☐ Note

H. Odom Reading ☐ OK

I. Fuel level, 1/4-tank min,; add if required.

J. Start-up per Mfg. instructions ☐ OK

K. Drive AMA route ☐ OK

### II. AMA PRECONDITIONING

| | | | | |
|---|---|---|---|---|
| A. Engine Start | ☐ Good | | ☐ Hard | ☐ False |
| B. Ignition Switch | ☐ OK | | ☐ Other | |
| C. Starter Motor | ☐ OK | | ☐ Grinds | ☐ No Start |
| D. Fast Idle | ☐ OK | | ☐ None | ☐ Engine Hot |
| E. Transmission | ☐ OK | | ☐ Shifts Hard | |
| F. Clutch | ☐ OK | Grabs | ☐ Slips | ☐ N/A |
| G. Brakes | ☐ OK | Fade | ☐ Poor | ☐ None |
| H. Driveability | ☐ Surge<br>Engine Miss ☐<br>☐ OK | ☐ Stumble | ☐ Back Fire<br>Diesels ☐ | ☐ Stretchy |

Driver's Signature ______________________________

Form 701-01

## II. SPECIFICATION CHECK INITIAL

A. Idle CO Rt ________ % Lt ________ % ________

B. Engine RPM Idle ______ Drive _____ ________

C. Ignition Timing __________ @ __________ in D☐ /N☐ ________

D. Fuel Drain ________

E. Wheel to driveshaft ratio
10 wheel turns to __________ driveshaft revs. N/V ____ ________

F. Tire size _______ x _______. ________

G. Vehicle Weight __________ with _________ tank fuel ________

H. Add 40% evap. fuel. Witness Sig. _____________ ____________

---

## IV. DYNAMOMETER HOT LA-4

A. Drive vehicle onto dyno.
Set inertia ______ lbs. @ ___________ H.P.

B. Check Varian. ☐ Paper-OK ☐ Pen-OK ☐ Ink-OK ☐ Zero-OK

C. Start Cooling Fan ☐ OK ☐ Release Dyno Brake-OK
☐ Tire Pressure 45 P.S.I.-OK

D. Hook-up ☐ Chock Blocks-OK ☐ Cable Winch ☐ Exhaust

E. Drive to Soak Area per schedule.

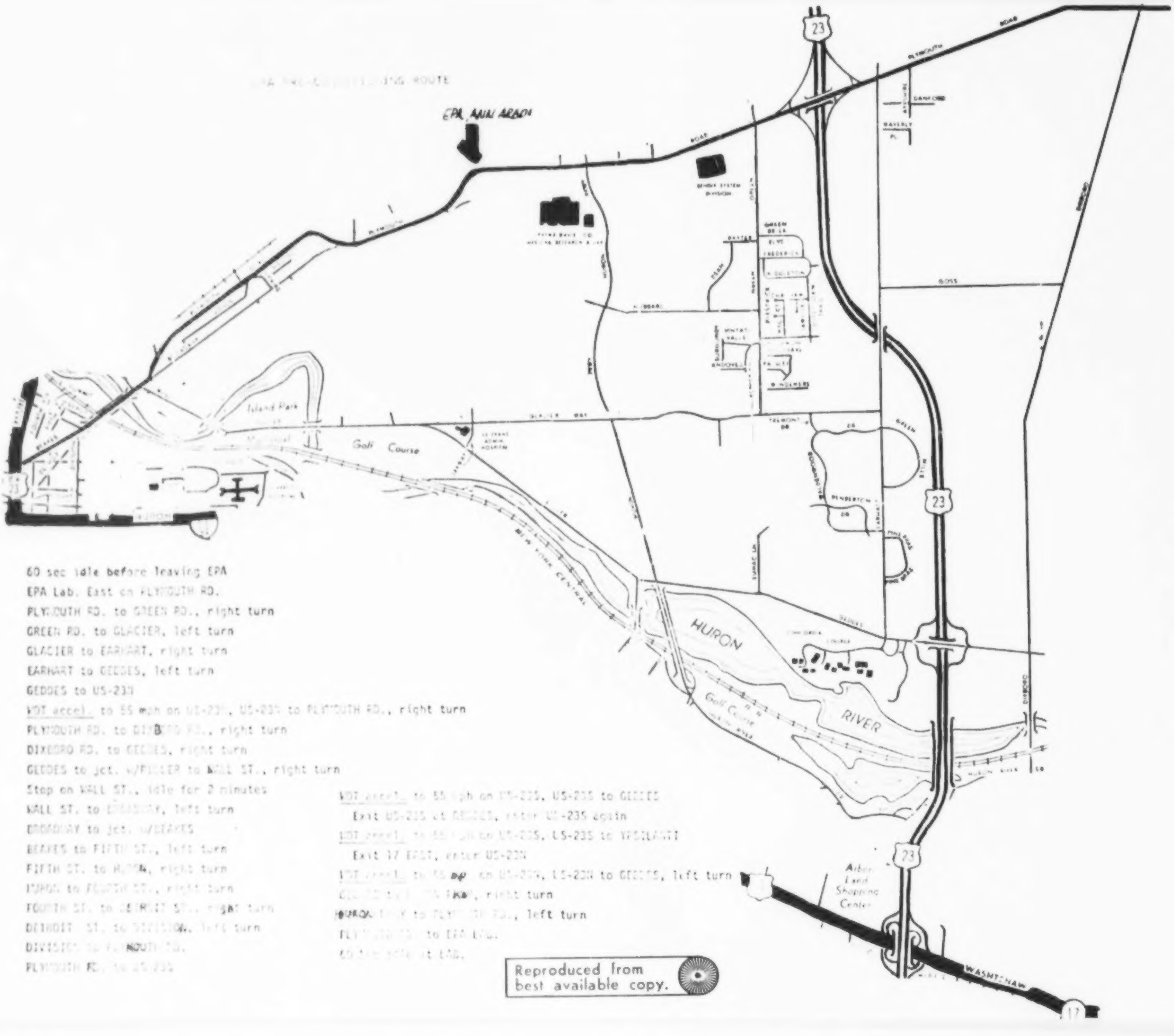
F. 11-Hour Soak Start __________________ (DO NOT RE-START ENGINE AFTER SHUT DOWN).

G. DO NOT START TEST BEFORE ___________ AM/PM. (Add 11 hours to hot soak start time).

Technician's Signature ____________________________________________

Leader/Supv. Signature ____________________________________________

# ATTACHMENT A (TP-702)


EPA PRE-CONDITIONING ROUTE
EPA ANN ARBOR
PLYMOUTH ROAD
23
GLACIER WAY
Island Park
Golf Course
NEW YORK CENTRAL
HURON RIVER
Golf Course
GEDDES
DIXBORO
GOSS
GREEN
Arbor Land Shopping Center
WASHTENAW
17
HURON

60 sec idle before leaving EPA
EPA Lab. East on PLYMOUTH RD.
PLYMOUTH RD. to GREEN RD., right turn
GREEN RD. to GLACIER, left turn
GLACIER to EARHART, right turn
EARHART to GEDDES, left turn
GEDDES to US-23N
WOT accel. to 55 mph on US-23N, US-23N to PLYMOUTH RD., right turn
PLYMOUTH RD. to DIXBORO RD., right turn
DIXBORO RD. to GEDDES, right turn
GEDDES to jct. w/FULLER to WALL ST., right turn
Stop on WALL ST., idle for 2 minutes
WALL ST. to BROADWAY, left turn
BROADWAY to jct. w/BEAKES
BEAKES to FIFTH ST., left turn
FIFTH ST. to HURON, right turn
HURON to FOURTH ST., right turn
FOURTH ST. to DETROIT ST., right turn
DETROIT ST. to DIVISION, left turn
DIVISION to PLYMOUTH RD.
PLYMOUTH RD. to US-23S

WOT accel. to 55 mph on US-23S, US-23S to GEDDES
Exit US-23S at GEDDES, enter US-23S again
WOT accel. to 55 mph on US-23S, US-23S to YPSILANTI
Exit 17 EAST, enter US-23N
WOT accel. to 55 mph on US-23N, US-23N to GEDDES, left turn
GEDDES to HURON PKWY, right turn
HURON PKWY to PLYMOUTH RD., left turn
PLYMOUTH RD. to EPA LAB.
60 sec idle at LAB.

Reproduced from best available copy.

# EPA TEST PROCEDURE

Number TP-703

Page 1 of 4

SUBJECT

"LA-4" VEHICLE PREPARATION

Reference FEDERAL REGISTER, VOL. 38, NO. 209, OCT. 31, 1973 - 85.075-12

Data Form No. 701-01; SECTION IV

Responsible Organization
TEST OPERATIONS

Computer Program
NONE

Test Witness /REVIEW
MANUFACTURER'S REPRESENTATIVE, EPA CERTIFICATION ENGINEER

Performance Interval
PER CERT.VEHICLE

Type of Test Report
DATA SHEET

Supersedes
NEW

Report Distribution QUALITY ASSURANCE, DATA VALIDATION, CERTIFICATION BRANCH, TEST DATA FILE

Superseded by

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab. Branch | Chief | | |
| Lab. Branch | Test Operations Chief | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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| REVISIONS: | "LA-4" VEHICLE PREPARATION | PROCEDURE NO. TP-703 |
|---|---|---|
| | **TEST PROCEDURE** | PAGE 2 OF 4 |

## 1.0 PURPOSE

To prepare certification vehicles for evaporative emission collection.

## 2.0 TEST ARTICLE DESCRIPTION

2.1 Test vehicle prepared by manufacturer

## 3.0 REFERENCES

3.1 Federal Register, Vol. 38, No. 209, Oct. 31, 1973 - 85.075-12

3.2 EPA TRAINING MANUAL, "Light Duty Certification Testing Procedures"

## 4.0 REQUIRED EQUIPMENT

4.1 Chassis dynamometer

4.2 Drivers aid, Varian

4.3 Cooling fan

## 5.0 PRECAUTIONS

5.1 Assure vehicle is tied down with winch cable

5.2 Inflate tires to 45 psi

5.3 Insure room temperature is within 68° to 86°F.

## 6.0 VISUAL INSPECTION

6.1 Check for proper set-up of test equipment.

## 7.0 TEST ARTICLE PREPARATION

7.1 Add evaporative test fuel to 20% of tank capacity
NOTE: Technician and witness must sign the "Fuel Log" located in fueling area.

7.2 Drive vehicle onto the dynamometer. Shut off engine.

7.3 Install chocks at front wheels and tie down with winch cable. Release Dyno brake first or the cable will be too taught.

7.4 Hook up exhaust vent system to vehicle.

7.5 Place cooling fan in front of vehicle and turn fan on.

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| REVISIONS: | "LA-4" VEHICLE PREPARATION<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-703<br>**PAGE** 3 **OF** 4 |
|---|---|---|

8.0 TEST PROCEDURES

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Set inertia weight and hp per manufacturer's recommendation. Release dyno brake. | |
| 102 | Calibrate driver's aid at 50 mph and zero. | |
| 103 | Drive the hot LA-4, following tolerances stated in paragraph 85.075-14 of the Federal Register. | Driver's Chart |
| 104 | Upon completion of the LA-4 shut-off fan, engage the dyno brake, remove exhaust vent system, disconnect winch cable and remove chocks. | |
| 105 | Drive vehicle to soak area, shut-off engine, record the start time of the eleven hour soak. | Date, Time |
| 106 | Lock the vehicle and return the keys to the Production Control office. | |

9.0 DATA INPUT

9.1 Insure Section IV of form 701-01 is complete.

9.2 Submit completed form and drivers trace to Data Validation.

10.0 DATA ANALYSIS

10.1 Check Section IV for missing data, and required signatures.

11.0 DATA OUTPUT

11.1 Form 701-01 becomes a permanent record of the test data package.

12.0 ACCEPTANCE CRITERIA

12.1 All entries must be complete and signed by the responsible technician and his supervisor.

12.2 Assure the LA-4 was driven within specified FTP driving limits. (see procedure #706, sec. 12.0)

13.0 QUALITY CONTROL PROVISIONS

13.1 If all entries and provisions stated in this procedure have been met, enter technician's EPA I.D. number on data sheet.

## F.T.P. MINUS EVAP PLUS F.E.T.

## DRIVER'S PRECONDITIONING REPORT

Vehicle mfgr. ____________________ No. ____________________

Time Out ____________ Time In ____________ Odom ____________

Date ____________________ Test# ____________________

### I. VEHICLE INSPECTION

A. Valid License Plate ☐ OK ☐ None

B. Exhaust Adaptor ☐ OK ☐ None

C. Fuel Drain ☐ OK ☐ None

D. Vehicle Damage (note on reverse) ☐ OK ☐ Note

E. Equip. not connected notify Prod. Cont. ☐ OK ☐ Note

F. Mfgr's Data Sheet ☐ OK ☐ None

G. Oil level; if low notify Prod. Cont. ☐ OK ☐ Note

H. Odom Reading ☐ OK

I. Fuel level, 1/4-tank min,; add if required.

J. Start-up per Mfg. instructions ☐ OK

K. Drive AMA route ☐ OK

### II. AMA PRECONDITIONING

| | | | | | |
|---|---|---|---|---|---|
| A. | Engine Start | ☐ Good | | ☐ Hard | ☐ False |
| B. | Ignition Switch | ☐ OK | | ☐ Other | |
| C. | Starter Motor | ☐ OK | | ☐ Grinds | ☐ No Start |
| D. | Fast Idle | ☐ OK | | ☐ None | ☐ Engine Hot |
| E. | Transmission | ☐ OK | | ☐ Shifts Hard | |
| F. | Clutch | ☐ OK | Grabs | ☐ Slips | ☐ N/A |
| G. | Brakes | ☐ OK | Fade | ☐ Poor | ☐ None |
| H. | Driveability | ☐ Surge<br>Engine Miss ☐<br>☐ OK | ☐ Stumble | ☐ Back Fire<br>Diesels ☐ | ☐ Stretchy |

Driver's Signature ________________________________

Form 701-01

## II. SPECIFICATION CHECK

**INITIAL**

A. Idle CO Rt________% Lt________% ________

B. Engine RPM Idle______ Drive______ ________

C. Ignition Timing __________@__________in D☐/N☐ ________

D. Fuel Drain ________

E. Wheel to driveshaft ratio
10 wheel turns to __________driveshaft revs. N/V____ ________

F. Tire size _______x_______. ________

G. Vehicle Weight __________with _________ tank fuel ________

H. Add 40% evap. fuel. Witness Sig. _____________ _____________

---

## IV. DYNAMOMETER HOT LA-4

A. Drive vehicle onto dyno.
Set inertia ______lbs. @___________H.P.

B. Check Varian. ☐Paper-OK ☐Pen-OK ☐Ink-OK ☐Zero-OK

C. Start Cooling Fan ☐OK ☐Release Dyno Brake-OK
☐Tire Pressure 45 P.S.I.-OK

D. Hook-up ☐Chock Blocks-OK ☐Cable Winch ☐Exhaust

E. Drive to Soak Area per schedule.

F. 11-Hour Soak Start __________________ (DO NOT RE-START ENGINE AFTER SHUT DOWN).

G. DO NOT START TEST BEFORE ___________AM/PM. (Add 11 hours to hot soak start time).

Technician's Signature______________________________

Leader/Supv. Signature______________________________

**EPA TEST PROCEDURE**

Number TP-704

Page 1 of 5

SUBJECT

TEST VEHICLE FUELING PROCEDURES

Reference: EPA MEMO DATED: 9-5-74

Data Form No.: 704-01

Responsible Organization: TEST OPERATION

Computer Program: NONE

Test Witness/REVIEW: PREP. TEAM LEADER

Performance Interval: PER. CERT. VEHICLE

Type of Test Report: DATA SHEET

Supersedes: NEW

Report Distribution: QUALITY ASSURANCE, TEST OPERATIONS, CERTIFICATION BRANCH

Superseded by

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| PROGRAM MGMT. | QUALITY ASSURANCE | | |
| LAB. BRANCH | CHIEF | | |
| LAB. BRANCH | TEST OPERATIONS CHIEF | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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1.0 PURPOSE

This procedure is designed to assure that the correct fuel is put into each certification vehicle.

2.0 TEST ARTICLE DESCRIPTION

Certification vehicle.

3.0 REFERENCES

3.1 EPA MEMO, - "TEST VEHICLE FUELING PROCEDURES," 9-5-74.

3.2 EPA, ANN ARBOR, DRAFT, "LIGHT DUTY TEST OPERATIONS."

4.0 REQUIRED EQUIPMENT

4.1 Fuel Conditioning Carts and Related Equipment. (i.e., nozzles, etc.)

4.2 Fuel-Indolene HO clear (unleaded) or Indolene 30 (leaded)

4.3 Remote Control Door Openers.

5.0 PRECAUTIONS

5.1 All safety precautions for vehicle fueling must be followed.

- o No smoking
- o Electrical equipment grounded
- o Fuel carts grounded with ground cables (not to insulated bumpers)
- o Vehicle being fueled must be grounded
- o "Absorbent" material to cover fuel and oil spills

5.2 Assure lead fuel is not used for catalyst equipped vehicles.

6.0 VISUAL INSPECTION

6.1 Assure ground cables are properly connected.

6.2 Check for proper color coding of fuel used for vehicles

6.2.1 Indolene 30 "leaded" marked with green paint

6.2.2 Indolene HO-clear "unleaded' marked with red or orange paint.

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## 7.0 TEST ARTICLE PREPARATION

7.1 All fuel nozzles, data sheets, vehicles, and fuel carts are marked a color code relating to fuel requirement.

- Orange or red for Indolene HO clear (unleaded)
- Green for Indolene 30 (leaded)

7.2 Before driving the "AMA" cycle, the driver must obtain the appropriate remote control unit from Production Control. NOTE: Remote controls have frequencies corresponding to the applicable fuel prep cell.

**REVISIONS:**

TEST VEHICLE FUELING

**TEST PROCEDURE**

**PROCEDURE NO.** TP-704

**PAGE** 4 **OF** 5

## 8.0 TEST PROCEDURE

The test vehicle fueling procedures specified below must be followed in all instances to assure proper fuel handling.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Production Control will stamp the fuel requirements on all work sheets and check lists associated with each vehicle. | Color Code |
| 102 | The prep. technician will place appropriate orange or green label next to the fuel filler door, steering wheel area and on the side window. | |
| 103 | Fuel nozzles in each of the two prep cells is appropriately color coded. Assure the color matches that on the vehicle. | |
| 104 | Upon return from the "AMA" route enter the prep cell that opens when the remote control unit is activated. | |
| 105 | Before fueling any test vehicle, verify the type of fuel required and nozzle type. The check sheet is to be signed by the technician and EPA witness. | |
| 106 | Following the vehicle fueling the technician and EPA witness shall log the date, vehicle, vehicle number, type of fuel, and number of gallons pumped on the Vehicle Test Fuel Record," and sign it off. | Date, Vehicle, Vehicle type, Fuel, Gals. |

## 9.0 DATA INPUT

9.1 Sign off checksheet #705-01 (Section I) and Section III of form #702-01.

9.2 Fill out the "Vehicle Test Fuel Record," form #704-01.

## 10.0 DATA ANALYSIS

None required

## 11.0 DATA OUTPUT

11.1 Forms 702-01 and 705-01 stay with vehicle until all tests are complete.

## 12.0 ACCEPTANCE CRITERIA

12.1 Assure the proper fuel has been dispensed for each vehicle.

12.2 All forms must be completed and signed.

## 13.0 QUALITY CONTROL PROVISIONS

13.1 Reject vehicle data if improper fueling has occurred and contact supervisor and manufacturers representative for disposition of the vehicle and appropriate corrective action to follow.

13.2 Institute corrective action (drain improper fuel) and repeat the procedure.

## VEHICLE TEST FUEL RECORD

FUEL TYPE: 1. ____________ PUMP READING: 1. ____________

2. ____________ 2. ____________

3. ____________ 3. ____________

PREP ROOM # ____________

| DATE | VEHICLE | VEHICLE NO. | TYPE FUEL | GALS. | SIGNATURE OF TECH | SIGNATURE WITNESS |
|---|---|---|---|---|---|---|
| | | | | | | |
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· FORM 704-01

## VEHICLE TEST AND EVAPORATIVE DATA

Vehicle Mfgr. ______________________________ No. ____________________

Inertia Wt. __________ HP __________ A/C __________ Test # ______________

---

## I. HEAT BUILD

| | TECH | CTA |
|---|---|---|
| A. Drain fuel | ☐ | ☐ |
| B. Plumb air cleaner | ☐ | ☐ |
| C. Plumb canister | ☐ | ☐ |
| D. Plumb bowl vent (if required) | ☐ | ☐ |
| E. Trap gas cap (if required) | ☐ | ☐ |
| F. Seal orifices/vents | ☐ | ☐ |
| G. Install carbon traps (record on data sheet) | ☐ | ☐ |
| H. Hook-up temperature recorder | ☐ | ☐ |
| I. Hook-up thermocouple leads | ☐ | ☐ |
| J. Install heat blanket | ☐ | ☐ |
| K. Plug in fuel tank heater (when used) | ☐ | ☐ |
| L. Refuel vehicle - 40% of tank capacity | ☐ | ☐ |

Tech. Sig. ____________________ Witness Sig. ____________________

M. Replace fuel cap, plug exhaust pipe(s) Unclamp canister ☐ ☐

| Heat Build Progress | Fuel Temp. Lead No. 1 | Fuel Temp. Lead No. 4 | Ambient Temp. |
|---|---|---|---|
| 0-Min. | | | |
| 15-Min. | | | |
| 30-Min. | | | |
| 45-Min. | | | |
| 60-Min. | | | |

---

## II. DYNAMOMETER WARM-UP/SET

A. Drive non-test vehicle onto dyno B. Hook-up vehicle as for Hot LA-
C. Set inertia______lbs.@_____ H.P. D. Drive @50mph steady state
E. Remove vehicle from dyno

I. Tech. Sig. ______________________________ Date ______________

II. Tech. Sig. ______________________________ Date ______________

FORM 705-01 (Continued)

## III. MASS EXHAUST EMISSIONS TEST

A. Check Varian Paper-OK☐ Pen-OK☐ Ink-OK☐ Zero-OK☐

B. Cooling fan in place OK☐ Release dyno brake-OK ☐

C. Hook up Chock blocks-OK☐ Cable winch☐ Exhaust ☐

D. Temp. recorder Connect thermocouple leads☐ Start recorder ☐

E. CVS Check fan operation☐ Bags-OK☐ Rev. Ctr. Zero ☐
Leak check-OK ☐ CVS Temp-OK ☐
Cell temp-OK ☐ Return to sample ☐

F. Drive test trace ☐ Check tire pressure (45 PSI) ☐

G. Remove vehicle to Soak Area ☐

---

## IV. HOT SOAK EVAPORATIVE EMISSIONS TEST

| | TECH | CTA |
|---|---|---|
| A. Reseal orifices/Vents | ☐ | ☐ |
| B. Reconnect carbon canisters and unclamp | ☐ | ☐ |
| C. Reconnect temp. recorder and thermocouple leads | ☐ | ☐ |
| D. Check gas cap | ☐ | ☐ |
| E. Plug exhaust pipe(s) | ☐ | ☐ |
| F. 1-hour soak Start time______ End______ | ☐ | ☐ |
| G. Start amb. temp.______ End amp. temp.______ | ☐ | ☐ |
| H. Check ambient temp. at 15-min. intervals | ☐ | ☐ |
| I. End of hot soak - reclamp canisters and remove | ☐ | ☐ |
| J. Shut-off temp. recorder | ☐ | ☐ |
| K. Weigh canisters and record on data sheet | ☐ | ☐ |

---

## V. DE-PREP AND VEHICLE REMOVAL

| | | |
|---|---|---|
| A. Remove all collection tubing, exhaust pipe plug(s), orifice/vent plugs, tape, foil, etc. | ☐ | ☐ |
| B. Disconnect temp. recorder & thermocouple leads | ☐ | ☐ |
| C. Return engine to Mfgr's running configuration | ☐ | ☐ |
| D. Move vehicle to East lot - keys to Prod. Contr. | ☐ | ☐ |
| E. "VOID" or "FAILED" vehicles - check with Team Leader for disposition | | |
| F. Leave as is, if acceptable for HWFET | | |

III. Tech. Sig.______________________ Date__________

IV. Tech. Sig.______________________ Date__________

V. Tech. Sig.______________________ Date__________

| | | |
|---|---|---|
| **EPA TEST PROCEDURE** | Number TP-705 | Page 1 of 6 |

SUBJECT
DIURNAL EVAPORATIVE TEST (HEAT BUILD)

| | |
|---|---|
| Reference FEDERAL REGISTER, VOL. 38, NO. 209, Oct. 31, 1973, Section 85.075-13 - 85.075-21 | Data Form No.<br>705-01.02 |
| Responsible Organization<br>TEST OPERATIONS | Computer Program |
| Test Witness/Review<br>MANUFACTURER"S EPA REPRESENTATIVE | Performance Interval<br>As per each Cert.Veh. |
| Type of Test Report<br>DATA SHEET | Supersedes<br>NEW |
| Report Distribution<br>CERTIFICATION BRANCH, DATA VALIDATION, QUALITY ASSURANCE | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Chief | | |
| Lab Branch | Test Operations Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Cnange | Approval | Date |
|---|---|---|---|
| | | | |

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| REVISIONS: | DIURNAL EVAPORATIVE TEST (HEAT BUILD) | PROCEDURE NO.<br>TP-705 |
|---|---|---|
| | **TEST PROCEDURE** | PAGE 2 OF 6 |

## 1.0 PURPOSE

To quantify evaporative emission losses occurring during a simulated diurnal temperature rise period.

## 2.0 TEST ARTICLE DESCRIPTION

2.1 Certification Test Vehicle.

## 3.0 REFERENCES

3.1 Federal Register, Vol. 38, No. 209, Oct. 31, 1973 - Sec. 85.075-13, 85.075-21

3.2 EPA Training Manual, "Light Duty Certification Testing Procedures."

## 4.0 REQUIRED EQUIPMENT

4.1 Drying tubes - 3/4 in. ID, tubular, transparent

4.2 Desiccant, 8 mesh

4.3 Collection tubing, stainless or aluminum, 5/16 ID.

4.4 PVC tubing, 5/16 ID.

4.5 Hosecock clamps, rubber plugs, aluminum foil, tape

4.6 Balance - accuracy ±.075 grams

4.7 Temperature recorder, multi-channel, range 50° to 100°F, accuracy ±1°F

4.8 Type "J" thermocouples, iron-constantine

4.9 Carbon traps, activated carbon, 300 ±25 ml, capacity 150 gms activated carbon

4.9.1 Heat blanket

## 5.0 PRECAUTIONS

5.1 Follow vehicle fueling safety precautions

5.2 Soak temperature (ambient) must be between 76°F and 86°F.

5.3 Do not place canisters on floor or suspend from collection tubing, DO NOT KINK LINES. Place canister on a stand.

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| REVISIONS: | DIURNAL EVAPORATIVE TEST (HEAT BUILD) | PROCEDURE NO. TP-705 |
|---|---|---|
| | **TEST PROCEDURE** | PAGE 3 OF 6 |

6.0 VISUAL INSPECTION

6.1 Inspect all plumbing and electrical connections.

6.2 Check color coding to insure proper evap. fuel is used.

7.0 TEST ARTICLE PREPARATION

7.1 Drain the fuel tank completely.

7.2 Install collection tube on the air cleaner.

7.3 Install collection tube on the vehicle carbon canister.

7.4 Seal all other orifices and vents to the atmosphere including exhaust pipe(s) and heat stove orifice.

7.5 Install collection tube on open bowl vent.

7.6 Seal fuel cap area for carbon trap after fuel is put in.

7.7 Install the temperature recorder.

7.7.1 Plug the thermocouple lead coming from the fuel tank into Channel 1.

7.7.2 Install a two foot thermocouple lead under the hood by taping "J" type thermocouple to the air cleaner snorkel. The connector should hang outside of the engine compartment on the right side of the vehicle. Plug into Channel 4.

7.7.3 Channel 2 of the temperature is permanently designated as the ambient room temperature hook-up.

7.7.4 Insure that all applicable switches inside of the recorder are turned on.

7.8 Install a heat-blanket on cars without one previously installed. Use one blanket on each tank if the vehicle has dual tanks. NOTE: DO NOT PLUG BLANKET IN UNTIL THE TEST IS BEGUN!

## 8.0 TEST PROCEDURES

The following steps are to be followed to assure proper heat build for the diurnal breathing loss test. As each step is completed check off on data form 705-01.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Obtain carbon traps for each point to be sampled on the vehicle. | |
| 102 | Record the test number, date and vehicle make on the evaporative emission data sheet #705-01. | Test number Date, Vehicle make |
| 103 | Record the identification number marked on canisters and location on form #705-01. The lowest number will be placed on the air cleaner. | Canister number in descending order - location |
| 104 | Weigh each canister to the nearest 0.05 gram. If a deviation of ±.5 gram from the manufacturer's weight is discovered mark canister for return to manufacturer. | |
| 105 | Clamp, with hose-cock clamps, within 1 to 1-1/2 inches of the in/out tubes of the canisters. Cut off hose in excess of 4 inches. | |
| 106 | Weigh the canisters with the hose-cock clamps in the closed position. Mark the weight on the canisters and record on form #028-02 in the space marked initial weight. | Initial weight, grams |
| 107 | Recirculate evap. fuel in the fuel conditioning cart to allow for temperature stabilization. | |
| 108 | Add evap. fuel to the fuel tank, 40% of the fuel tank capacity. | Amount of fuel added |
| 109 | Turn on temperature recorder and monitor initial fuel temperature. Should be 60°F ±2°F, log on form #705-01 along with start time, temp. of lead #4 and ambient temp. | Fuel temp- Lead #1, Lead #4 ambient in °F start time |

| REVISIONS: | DIURNAL EVAPORATIVE TEST (HEAT BUILD)<br>**TEST PROCEDURE** | PROCEDURE NO. TP-705<br>PAGE 5 OF 6 |
|---|---|---|

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 110 | Replace the fuel cap, plug the exhaust pipe and unclamp the canisters. | |
| 111 | Attach hose from the top (inlet) of the canisters to the evaporative collection tubing on the vehicle. The hose from the side (outlet) of the canisters are attached to a desiccant tube. The open end of tubing from desiccant shall be taped at the approximate height of the trapping point to allow for pressure equalization. | |
| 112 | Start heat build; at 15 min. intervals record fuel temp. of (fuel tank), lead 4 (under hood and ambient temperatures on evap. data sheet #705-01. NOTE: Adjust variac to approximately 40. | Lead 1, Lead 4, ambient |
| 113 | At the end of one hour, shut off the variac, unplug and remove the heat blanket, clamp off the canisters (inlet side first) and return air cleaner and vehicle carbon canister to "running" configuration. | |
| 114 | Re-route fuel to carburetor and reinstall heat stove tube. Unplug tailpipe, temperature recorder and remove. | |
| 115 | Recheck to assure all orifices/vents to atmosphere are unobstructed; air cleaner, heat stove functioning; thermocouples and heat blanket disconnected; plugs removed from tailpipe(s). | |
| 116 | Push vehicle onto dynamometer for '75 FTP Emission test. | |

## 9.0 DATA INPUT

9.1 Fill in Test no., date, make of car, test no, canister numbers, location and initial wt. of canister on form #705-02 (Evaporative Emission Weighing Data).

9.2 Fill out section I "Heat Build" of form #705-01 (Vehicle Test and Evaporative Data).

## 10.0 DATA ANALYSIS

10.1 No analysis other than procedural verification is accomplished until the completion of the hot soak evap. test.

## 11.0 DATA OUTPUT

11.1 Form 705-01 stays with the test vehicle until the completion of the Hot Soak Evaporative Test and submitted to Data Verification following De-prep and removal.

11.2 Form 705-02 also remains with the test vehicle until the weight of the canister has been recorded for the Hot Soak Evap. Test.

## 12.0 ACCEPTANCE CRITERIA

12.1 During the heat build the fuel in the tank is to be heated from 60°F ±2°F to 84°F ±2°F at a constant rate of change over a 1 hour ±10 minute period.

12.2 The ambient temperature of the soak area must remain within the 76°F to 86°F band.

12.2 After a minimum of one hour in the soak area the vehicle must be moved (pushed) onto the dynamometer for the '75 FTP.

## 13.0 QUALITY PROVISIONS

13.1 Form #705-01 has a built in quality check in Section I. Each step performed is checked off by the technician and then checked and signed off by a witness, thus an audit is performed at the site of the test.

13.2 Heat build progress should be audited by the Q.A. department to assure the specified limits have not be exceeded.

13.3 All deviations (if any) from the prescribed procedure should be documented fully on form 705-01.

## VEHICLE TEST AND EVAPORATIVE DATA

Vehicle Mfgr.____________________________ No.__________________

Inertia Wt.__________ HP__________ A/C_________ Test # ______________

---

| I. HEAT BUILD | TECH | CTA |
|---|---|---|
| A. Drain fuel | ☐ | ☐ |
| B. Plumb air cleaner | ☐ | ☐ |
| C. Plumb canister | ☐ | ☐ |
| D. Plumb bowl vent (if required) | ☐ | ☐ |
| E. Trap gas cap (if required) | ☐ | ☐ |
| F. Seal orifices/vents | ☐ | ☐ |
| G. Install carbon traps (record on data sheet) | ☐ | ☐ |
| H. Hook-up temperature recorder | ☐ | ☐ |
| I. Hook-up thermocouple leads | ☐ | ☐ |
| J. Install heat blanket | ☐ | ☐ |
| K. Plug in fuel tank heater (when used) | ☐ | ☐ |
| L. Refuel vehicle - 40% of tank capacity | ☐ | ☐ |

Tech. Sig.__________________ Witness Sig.__________________

| M. Replace fuel cap, plug exhaust pipe(s) Unclamp canister | ☐ | ☐ |
|---|---|---|

| Heat Build Progress | Fuel Temp. Lead No. 1 | Fuel Temp. Lead No. 4 | Ambient Temp. |
|---|---|---|---|
| 0-Min. | ______ | ______ | ______ |
| 15-Min. | ______ | ______ | ______ |
| 30-Min. | ______ | ______ | ______ |
| 45-Min. | ______ | ______ | ______ |
| 60-Min. | ______ | ______ | ______ |

---

II. DYNAMOMETER WARM-UP/SET

A. Drive non-test vehicle onto dyno B. Hook-up vehicle as for Hot LA-4
C. Set inertia_____lbs.@_____H.P. D. Drive @50mph steady state
E. Remove vehicle from dyno

I. Tech. Sig.____________________________ Date______________

II. Tech. Sig.____________________________ Date______________

FORM 705-01

FORM 705-01 (Continued)

## III. MASS EXHAUST EMISSIONS TEST

A. Check Varian Paper-OK☐ Pen-OK☐ Ink-OK☐ Zero-OK☐

B. Cooling fan in place OK☐ Release dyno brake-OK ☐

C. Hook up Chock blocks-OK☐ Cable winch☐ Exhaust ☐

D. Temp. recorder Connect thermocouple leads☐ Start recorder ☐

E. CVS Check fan operation☐ Bags-OK ☐ Rev. Ctr. Zero ☐
Leak check-OK ☐ CVS Temp-OK ☐
Cell temp-OK ☐ Return to sample ☐

F. Drive test trace ☐ Check tire pressure (45 PSI) ☐

G. Remove vehicle to Soak Area ☐

---

## IV. HOT SOAK EVAPORATIVE EMISSIONS TEST

| | | TECH | CTA |
|---|---|---|---|
| A. | Reseal orifices/vents | ☐ | ☐ |
| B. | Reconnect carbon canisters and unclamp | ☐ | ☐ |
| C. | Reconnect temp. recorder and thermocouple leads | ☐ | ☐ |
| D. | Check gas cap | ☐ | ☐ |
| E. | Plug exhaust pipe(s) | ☐ | ☐ |
| F. | 1-hour soak Start time______ End______ | ☐ | ☐ |
| G. | Start amb. temp.______ End amp. temp.______ | ☐ | ☐ |
| H. | Check ambient temp. at 15-min. intervals | ☐ | ☐ |
| I. | End of hot soak - reclamp canisters and remove | ☐ | ☐ |
| J. | Shut-off temp. recorder | ☐ | ☐ |
| K. | Weigh canisters and record on data sheet | ☐ | ☐ |

---

## V. DE-PREP AND VEHICLE REMOVAL

| | | | |
|---|---|---|---|
| A. | Remove all collection tubing, exhaust pipe plug(s), orifice/vent plugs, tape, foil, etc. | ☐ | ☐ |
| B. | Disconnect temp. recorder & thermocouple leads | ☐ | ☐ |
| C. | Return engine to Mfgr's running configuration | ☐ | ☐ |
| D. | Move vehicle to East lot - keys to Prod. Contr. | ☐ | ☐ |
| E. | "VOID" or "FAILED" vehicles - check with Team Leader for disposition | | |
| F. | Leave as is, if acceptable for HWFET | | |

III. Tech. Sig.______________________ ____________ Date____________

IV. Tech. Sig.__________________________________ Date____________

V. Tech. Sig.____________________ ____________ Date______ ______

## EVAPORATIVE EMISSION WEIGHING DATA

TEST NO. ______________________________

DATE ______________________________

MAKE OF CAR ______________________________

| | | | | |
|---|---|---|---|---|
| CANISTER NO. | | | | |
| CANISTER LOCATION | | | | |
| HOT SOAK WEIGHT | | | | |
| INITIAL WEIGHT | | | | |
| EVAP. EMISSIONS | | | | |

TOTAL EVAP. EMISSIONS ______________________________

FORM 705-02

**EPA TEST PROCEDURE**

| | |
|---|---|
| Number<br>TP-706 | Page 1 of 9 |

SUBJECT

1975 URBAN DYNO TEST - FTP

| | |
|---|---|
| Reference Federal Register, Vol.38, No.209, Oct.31, 1973 - Secs. 85.075-14 thru 19 and 24, 25, Appendix I | Data Form No.<br>705-01 |
| Responsible Organization<br>Test Operations | Computer Program<br>Analysis by SAQF:<br>NEWCVS |
| Test Witness/Review<br>Manufacturers EPA Representative | Performance Interval<br>Per Vehicle |
| Type of Test Report<br>Data Sheet | Supersedes<br>New |
| Report Distribution<br>Quality Assurance, Test Oper.,Data Validation,Cert. Branch | Superseded by |

REMARKS/COMMENTS

1.0 See procedure No. TP-707 for sample analysis of the 1975 FTP.

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt. | Quality Assurance | | |
| Lab. Branch | Chief | | |
| Lab. Branch | Test Operations Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

## 1.0 PURPOSE

To collect exhaust emissions utilizing a constant volume sampler. The dilute exhaust emissions are collected in sample bags. This sample is collected from a test vehicle which is being driven on a chassis dynamometer following the FTP driver's trace. The sample collected is then analyzed by the analysis system.
(Ref.TP-707).

## 2.0 TEST ARTICLE DESCRIPTION

2.1 Manufacturer's certification vehicle.

## 3.0 REFERENCES

3.1 Federal Register, Vol. 38, No. 209, Oct. 31, 1973, sections 85.075-14 through 19 and 85.075-24 through 25 and APPENDIX I.

3.2 EPA, Ann Arbor, Training Manual, "Light Duty Certification Testing Procedures."

## 4.0 REQUIRED EQUIPMENT

4.1 Constant Volume Sampler equipped to meet requirements in Federal Register, Sec. 85.075-20.

4.2 Chassis Dynamometer
- o Clayton model ECE-50

4.3 Drivers Aid
- o Varian
- o Hewlett-Packard

## 5.0 PRECAUTIONS

5.1 Perform dyno warm-up procedure (TP-604)

5.2 Ensure the hood of the test vehicle is closed and the cooling fan is turned off during the 10 minute soak.

## 6.0 VISUAL INSPECTION

6.1 Insure fan and tail pipe connector are in place.

6.2 Check bags for correct installation.

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## 7.0 TEST ARTICLE PREPARATION

7.1 Insure test vehicle is aligned properly on the dynamometer and tied down.

7.2 Inflate tires to 45 p.s.i.

7.3 Daily Start-up (System Check-out); check off in section III, form #705-01.

7.4 Check Varian for Paper, Ink and calibrate zero; check off as above.

7.5 Install sample bags

7.6 When the cell technician/CVS operator have confidence that the CVS and associated equipment are operating correctly, the analyzer operator will have the manufacturer's EPA representative check and approve vehicle for the test.

8.0 TEST PROCEDURE

The Mass Emission test data is collected as a result of the following procedural steps.

| Test Sequence | | Test Description | Data Output |
|---|---|---|---|
| 101 | Push test vehicle on the dyno. | | |
| | o | Release the dyno. brake. | Dyno. brk. of |
| | o | Secure vehicle with the down cable(s). | Cable winch |
| | o | Place chocks on front wheels | Chocks |
| | o | Install cooling fan 12 inches in front of vehicle and raise hood. | Cooling fan |
| | o | Install flexible exhaust hose. | Exhaust |
| | o | Connect thermocouple leads to temperature recorder and turn on. | Thermocouples<br>Start recorde |
| | o | Check form #705-01, section III. | |
| 102 | The CVS operator will: | | |
| | o | Zero counters | Rev. Ctr. Zer |
| | o | Turn on "dia. pumps" and "blower." | |
| | o | Inspect and install sample bags. | Bags |
| | o | Check CVS temperature. | CVS temp. |
| | o | Check cell temperature. | Cell temp. |
| 103 | Prior to entering the vehicle the driver will: | | |
| | o | Assure fuel is properly connected. | |
| | o | Become familiar with the manufacturer's starting procedure. | |
| 104 | The driver will: | | |
| | o | Enter vehicle. | |
| | o | Zero "drivers aid" and lower the pen. | |
| 105 | The operator will engage bags "1 and 3." | | |

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 106a | Proceed with manufacturer's starting procedures: | |
| | o Simultaneously start "counter" and crank engine. | |
| | o If engine starts and continues to run, turn on the driver's aid. | |
| 106b | If vehicle cranks for more than 10 seconds, take the following steps: | Long crank |
| | o Cease cranking | |
| | o Shut off "rev counter" | |
| | o Shut off CVS | |
| | o Manufacturer's representative has 30 min. to correct cause. | |
| | o Repeat starting procedures in 106a. | |
| 106c | If vehicle "false starts", repeat step 106a. | False start |
| | o If unable to restart vehicle before first accel, shut off varian until engine starts. | |
| | o If vehicle fails to start in 10 seconds, repeat step 106b. | |
| | o If vehicle "false starts" repeatedly for 60 seconds, the test is voided. | Void |
| 107 | If vehicle starts and runs properly, but stalls when shifted into gear at 15-second point, shut off varian and re-start vehicle, shift back into gear, re-start varian and continue test. | |
| 108 | When engine is started, the driver may use any means necessary to keep engine running, i.e., "feathering" accelerator, "slipping" clutch, etc. | |

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 109 | The driver will follow the Federal driver's trace, (see attachment A) with close attention given to the following:<br>o Follow trace as closely as possible to avoid "out of spec" conditions. (see attachment B for operating mode instructions)<br>o Monitor "trace" paper to assure it does not get hung up.<br>o In case of problems, blow horn for CVS operator. | |
| 110 | At the "505 second point" the driver will initiate sampling of "bags 2 and 4" for the "stabilized" phase of the test. | |
| 111 | At 1367 seconds the final idle begins.<br>o At 1369 sec. the ignition will be turned off.<br>o Five seconds after the engine stops turning, shut off the sample and counter.<br>o Read rev. counts. | rev. counts |
| 112 | After "rev. counter" has been turned off, the 10 min. soak begins. The driver will:<br>o Close the vehicle hood.<br>o Shut off cooling fan.<br>o Disconnect and shut off the CVS<br>o If fuel vents are being trapped, trap is removed during 10 min. soak and second 505. To be reconnected at beginning of hot soak. | |
| 113 | 9 Min. into the 10 min. soak, the driver will:<br>o Open hood.<br>o Turn on fan. | |

| Test Sequence | Test Description | Data Output |
|---|---|---|

114 The CVS operator will:

- o Install and evacuate "bags 1 and 2."
- o Zero counter.
- o Turn on dia. pumps and blower.

115 The driver will perform the following:

- o Roll "drivers chart" to the beginning of next test.
- o Start the "505 Hot" portion of test.

  NOTE: Must be started between 10 and and 11 mins. of soak.

116 At the end of "505" the CVS operator will turn off "rev counter."

117 Remove tie-downs, exhaust connector, cooling fan, put hood down, dyno roll brake up and drive the vehicle off dyno into the soak area at minimum throttle.

## 9.0 DATA INPUT

9.1 Fill out section III of form 705-01 as the required steps are performed and sign form.

9.2 Driver should sign and date the FTP "drivers trace."

## 10.0 DATA ANALYSIS

10.1 Drivers trace should be checked for "out of spec" conditions.

## 11.0 DATA OUTPUT

11.1 Form #705-01 is kept with vehicle until De-prep and removal has been accomplished.

11.2 Drivers trace is submitted to Data validation and becomes part of vehicle file.

## 12.0 ACCEPTANCE CRITERIA

12.1 Drivers trace generated from the FTP must be within the following limits. (See Figure 12-1.)

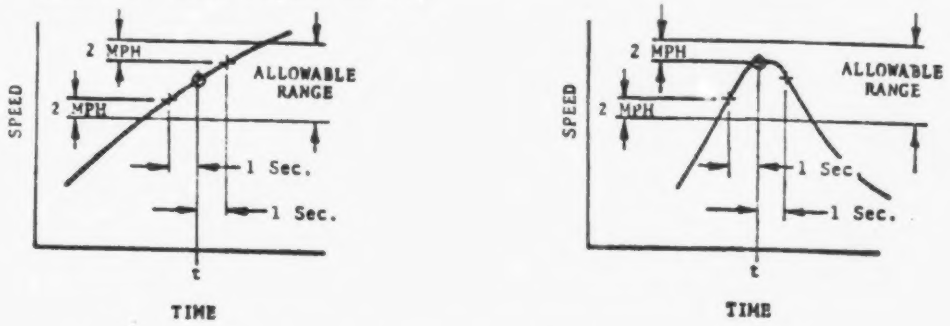


Fig. 12-1. ALLOWABLE LIMITS FOR FTP DRIVERS TRACE

12.1.1 The upper limit is 2 mph higher than the highest point being driven on the trace within 1 second of given time.

12.1.2 The lower limit is 2 mph lower than the lowest point being driven on the trace within 1 second of given time.

12.1.3 Speed variations greater than the tolerances described above (i.e., manual transmission shifting) are acceptable if they occur for less than 2 seconds on any occurrence.

12.1.4 Exceeding lower tolerance (12.1.2) is acceptable when restarting a stalled engine or if the vehicle is operated at W.O.T. (wide open throttle)

## 13.0 QUALITY PROVISIONS

13.1 The Quality Assurance section should inspect the drivers trace to assure the acceptable limits stated in section 12 have been followed.

13.2 If "out of limits" conditions are discovered, Quality Assurance should request corrective action. (i.e., have Production Control reschedule vehicle for test.)

## VEHICLE TEST AND EVAPORATIVE DATA

Vehicle Mfgr. ______________________________ No. ____________________

Inertia Wt. __________ HP __________ A/C __________ Test # ______________

---

| I. HEAT BUILD | TECH | CTA |
|---|---|---|
| A. Drain fuel | ☐ | ☐ |
| B. Plumb air cleaner | ☐ | ☐ |
| C. Plumb canister | ☐ | ☐ |
| D. Plumb bowl vent (if required) | ☐ | ☐ |
| E. Trap gas cap (if required) | ☐ | ☐ |
| F. Seal orifices/vents | ☐ | ☐ |
| G. Install carbon traps (record on data sheet) | ☐ | ☐ |
| H. Hook-up temperature recorder | ☐ | ☐ |
| I. Hook-up thermocouple leads | ☐ | ☐ |
| J. Install heat blanket | ☐ | ☐ |
| K. Plug in fuel tank heater (when used) | ☐ | ☐ |
| L. Refuel vehicle - 40% of tank capacity | ☐ | ☐ |

Tech. Sig. ____________________ Witness Sig. ____________________

| M. Replace fuel cap, plug exhaust pipe(s) Unclamp canister | ☐ | ☐ |
|---|---|---|

| Heat Build Progress | Fuel Temp. Lead No. 1 | Fuel Temp. Lead No. 4 | Ambient Temp. |
|---|---|---|---|
| 0-Min. | | | |
| 15-Min. | | | |
| 30-Min. | | | |
| 45-Min. | | | |
| 60-Min. | | | |

---

II. DYNAMOMETER WARM-UP/SET

A. Drive non-test vehicle onto dyno B. Hook-up vehicle as for Hot LA-
C. Set inertia ______ lbs.@ ______ H.P. D. Drive @50mph steady state
E. Remove vehicle from dyno

I. Tech. Sig. ______________________________ Date ______________

II. Tech. Sig. ______________________________ Date ______________

form 705-01

## III. MASS EXHAUST EMISSIONS TEST

A. Check Varian Paper-OK ☐ Pen-OK ☐ Ink-OK ☐ Zero-OK ☐

B. Cooling fan in place OK ☐ Release dyno brake-OK ☐

C. Hook up Chock blocks-OK ☐ Cable winch ☐ Exhaust ☐

D. Temp. recorder Connect thermocouple leads ☐ Start recorder ☐

E. CVS Check fan operation ☐ Bags-OK ☐ Rev. Ctr. Zero ☐
Leak check-OK ☐ CVS Temp-OK ☐
Cell temp-OK ☐ Return to sample ☐

F. Drive test trace ☐ Check tire pressure (45 PSI) ☐

G. Remove vehicle to Soak Area ☐

---

## IV. HOT SOAK EVAPORATIVE EMISSIONS TEST

| | TECH | CTA |
|---|---|---|
| A. Reseal orifices/vents | ☐ | ☐ |
| B. Reconnect carbon canisters and unclamp | ☐ | ☐ |
| C. Reconnect temp. recorder and thermocouple leads | ☐ | ☐ |
| D. Check gas cap | ☐ | ☐ |
| E. Plug exhaust pipe(s) | ☐ | ☐ |
| F. 1-hour soak Start time______ End______ | ☐ | ☐ |
| G. Start amb. temp.______ End amp. temp.______ | ☐ | ☐ |
| H. Check ambient temp. at 15-min. intervals | ☐ | ☐ |
| I. End of hot soak - reclamp canisters and remove | ☐ | ☐ |
| J. Shut-off temp. recorder | ☐ | ☐ |
| K. Weigh canisters and record on data sheet | ☐ | ☐ |

---

## V. DE-PREP AND VEHICLE REMOVAL

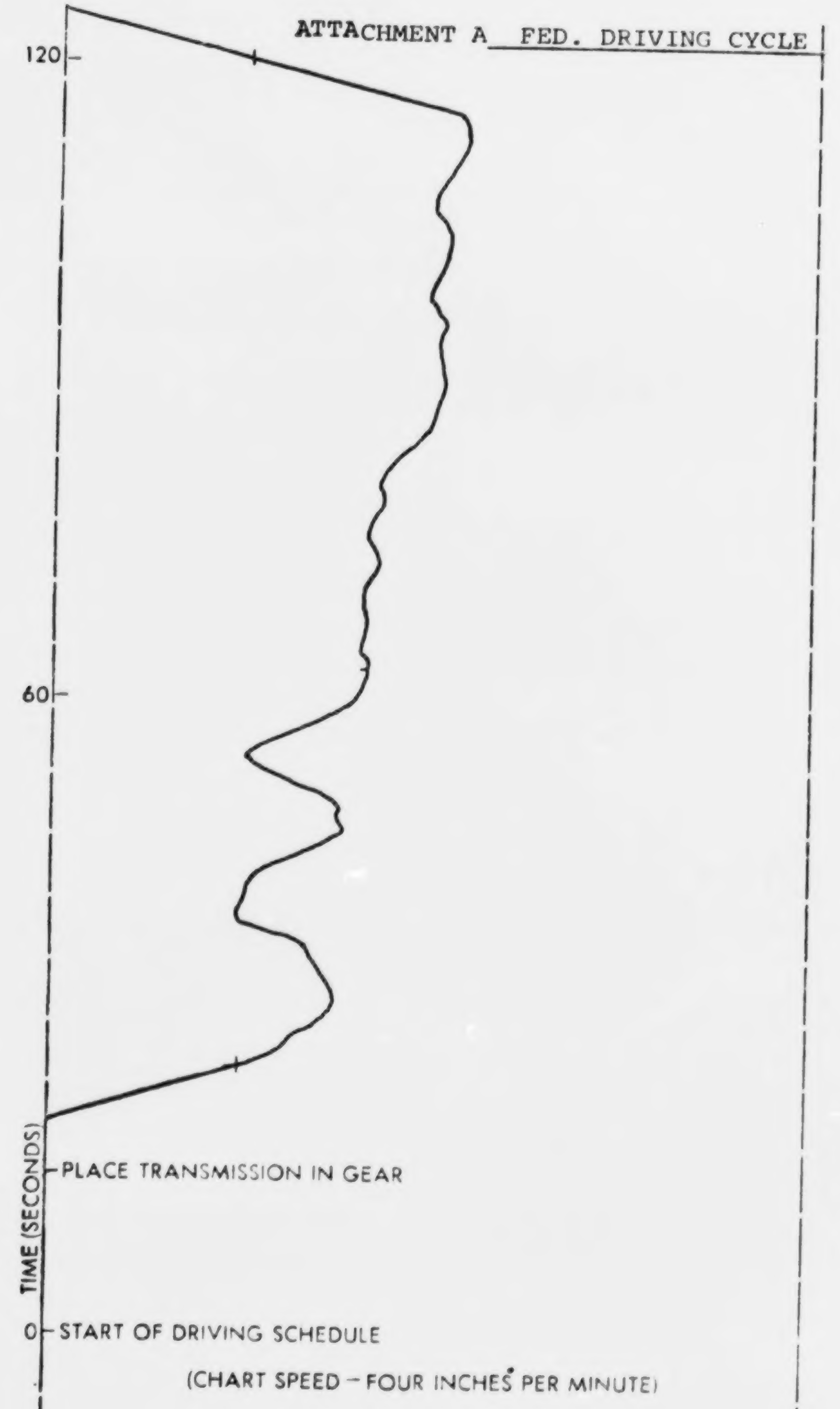
A. Remove all collection tubing, exhaust pipe plug(s), orifice/vent plugs, tape, foil, etc.
B. Disconnect temp. recorder & thermocouple leads ☐ ☐
C. Return engine to Mfgr's running configuration ☐ ☐
D. Move vehicle to East lot - keys to Prod. Contr. ☐ ☐
E. "VOID" or "FAILED" vehicles - check with Team Leader for disposition ☐ ☐
F. Leave as is, if acceptable for HWFET

III. Tech. Sig.____________________ __________ Date__________

IV. Tech. Sig.______________________________ Date__________

V. Tech. Sig.________________ __________ Date__________

ATTACHMENT A FED. DRIVING CYCLE



(CHART SPEED – FOUR INCHES PER MINUTE)

FEDERAL DRIVING SCHEDULE

FEDERAL REGISTER

Revised Volume 36 · Number 55 · March 20, 1971

## ATTACHMENT B - DRIVER'S OPERATING INSTRUCTIONS FOR 1975 FTP

1. ALL OPERATING MODES

   a. AUTOMATIC TRANSMISSIONS must always be in DRIVE position, except during first idle and when restarting engines.

   b. BRAKES and ACCELERATOR must NOT be used simultaneously.

   c. STEERING WHEEL must NOT be turned during a test.

   d. MINIMUM THROTTLING must be used during all modes to maintain speed indicated on driving trace.

2. IDLES

   a. MANUAL TRANSMISSIONS must always be in gear with clutch disengaged during all idles, except the first.

   b. THROTTLING is NOT PERMITTED during any idle mode, except the first, to prevent stalling.

3. ACCELERATIONS

   a. ALL accelerations must be made SMOOTHLY without using brakes.

   b. If the vehicle cannot accelerate at the specified rates, accelerate at WIDE OPEN THROTTLE (WOT) until vehicle reaches speed required at that time during the driving trace. WOT must be noted on driving trace where it occurs.

   c. Vehicles equipped with FREE-WHEELING or OVERDRIVE UNITS shall be tested with the unit locked out of operation.

   d. AUTOMATIC STICK SHIFT transmission may be shifted as manual transmissions at the requestor's option for development testing only.

4. DECELERATIONS

   a. ALL decelerations must be made SMOOTHLY using brake or accelerator to maintain required speed.

   b. ALL decelerations must be made WITHOUT DOWNSHIFTING MANUAL TRANSMISSIONS unless indicated on the driving trace.

## ATTACHMENT B (continued)

c. DISENGAGE CLUTCH on manual transmissions when:

(1) Speed drops below 15 MPH.
(2) Engine ROUGHNESS is evident.
(3) Engine STALL is imminent.

## 5. SHIFTING

a. MANUAL transmissions must be quickly shifted during acceleration from:

(1) 1st to 2nd at 15 MPH.
(2) 2nd to 3rd at 25 MPH.
(3) 3rd to 4th at 40 MPH for 4-speed and 5-speed transmissions.
(4) 4th to 5th at requestor's option for 5-speed transmissions.

b. When shifting MANUAL transmission the ACCELERATOR PEDAL must be released as the CLUTCH is disengaged and the PEDAL depressed as necessary to maintain a smooth transition when CLUTCH is re-engaged.

c. If the FIRST GEAR RATIO exceeds 5:1 on a 4 OR 5 SPEED MANUAL TRANSMISSION, eliminate use of first gear and quickly shift during accelerations from:

(1) 2nd to 3rd at 15 MPH.
(2) 3rd to 4th at 25 MPH.
(3) 4th to 5th at 40 MPH for 5-speed transmissions.

NOTE: Requestor will specify first gear ratio if it exceeds 5:1.

d. DOWNSHIFT manual transmissions at the beginning of or during a power mode if the engine is obviously lugging. NOTE: "Lugging" on trace if downshift is required.

| **EPA TEST PROCEDURE** | Number<br>TP-707 | Page 1 of 7 |
|---|---|---|

SUBJECT

SAMPLE ANALYSIS OF 1975 URBAN DYNO TEST

| | |
|---|---|
| Reference Federal Register, Vol. 38, No. 29, Oct.31,1973<br>Sec. 85.075-15 & 85.075-20 | Data Form No.<br>707-01-02 |
| Responsible Organization<br>Test Operations | Computer Program<br>SAQF:NEWCVS |
| Test Witness/Review<br>Manufacturer's EPA Representative, Data Validation | Performance Interval<br>Per Vehicle |
| Type of Test Report<br>Computer Print-Out | Supersedes<br>New |
| Report Distribution Manufacturer/Certification Branch/<br>Data Validation/Quality Assurance | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt. | Quality Assurance | | |
| Lab. Branch | Chief | | |
| Lab. Branch | Test Operations Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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1.0 PURPOSE

To measure the bag concentrations collected by a constant volume sampler. This exhaust sample is diluted to a constant volume and collected in sample bags. The collected sample is then analyzed for hydrocarbons, carbon monoxide, carbon dioxide and oxides of nitrogen by a gas analysis system.

2.0 TEST ARTICLE DESCRIPTION

2.1 Manufacturer's Certification vehicle.

3.0 REFERENCES

3.1 Federal Register. Vol. 38, No. 209, Oct. 31, 1973, sec. 85.075-15 and 85.075-20.

3.2 EPA, Ann Arbor, Training Manual "Light Duty Certification Testing Procedures."

3.3 EPA, Ann Arbor, "Light Duty Test Operations," Draft.

4.0 REQUIRED EQUIPMENT

4.1 Constant Volume Sampler.

4.2 Mass Analytical System capable of measuring the following:

4.2.1 Hydrocarbons - Flame Ionization

4.2.2 Carbon Monoxide - Infra-red (NDIR)

4.2.3 Carbon Dioxide - Infra-red (NDIR)

4.2.4 Oxides of Nitrogen - Chemiluminescence

4.3 "Working" gas mixtures analyzed using EPA Primary Standards.

4.4 "Zero Gas", nitrogen or air, and fuel cylinder for FID.

5.0 PRECAUTIONS

5.1 Safety precautions should be followed when handling compressed gases. NO and CO are toxic gases!

5.2 Insure cylinders have adequate pressure for testing.

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5.3 Do not exceed maximum allowable time of 20 minutes after end of test when analyzing bag.

## 6.0 VISUAL INSPECTION

6.1 Check flow rates and pressures.

6.2 During the FTP and during analysis mode monitor all instruments, gauges, and recorders to assure no "out of spec" conditions exist.

## 7.0 TEST ARTICLE PREPARATION

7.1 Perform daily start-up on analyzer train.

7.2 Activate strip chart recorders and check zero/span.

7.3 Install sample bags and insure no leaks are present.

7.4 Change filter (sample) before FTP begins .

7.5 Start ambient temperature recorder.

## 8.0 TEST PROCEDURE

The 1975 Mass Emission Test results are calculated as a result of data collected from the following procedural steps.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Prior to starting the first "505" of the FTP the analyzer operator will calibrate the analyzers and generate span points on the chart recorders. | |
| 102 | After the driver has switched to bags 2 and 4 upon completion of the "505" the Analyzer operator will deliver "bags 1 and 3" to the analysis transfer system. | |
| 103 | The analyzer operator will first analyze the "background" sample (bag 1) and log the numerical range and value from chart traces of HC, CO, $CO_2$ $NO_x$ on form 707-02. | Bkgd.<br>HC, Defl.<br>CO, Defl.<br>$CO_2$, Defl.<br>$NO_x$, Defl. |
| 104 | Step 103 is repeated for the "sample" bag. (bag 3) | Deflections,<br>HC, CO, $CO_2$<br>$NO_x$ - Sample |
| 105 | Counts, mileage and seconds are recorded for first set of bags on form 707-01, CVS Data sheet. | Revs, secs., mileage |
| 106 | At the 660 point on the driver's trace for the odd numbered dyno, and 1020 sec. point for even number dyno the CVS operator will record the inlet and outlet pressure of the positive displacement pump on the CVS data sheet. | Inlet pressure<br>out. pressure<br>in inches of $H_2O$ |
| 107 | Recalibrate as shown in step 101. | |
| 108 | Upon completion of the transient phase of the FTP repeat steps 103 and 104 for "bags 2 and 4." Record on form 707-02. | Deflections,<br>HC, $CO_2$, and<br>$NO_x$. BKGD.<br>and sample. |
| 109 | Record counts, mileage and seconds for second set of bags on CVS data sheet. | Revs., secs., mileage |

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 110 | Recalibrate as shown in step 101 for final "505." | |
| 111 | Upon completion of "505" hot, repeat steps 103 and 104 for "bags 1 and 3." | Deflections, HC, CO, $CO_2$ $NO_x$. Bkgd. and sample. |
| 112 | Record rev. counts, mileage and seconds for the third set of bags. | Revs., secs., mileage |
| 113 | Perform a post calibration and record on chart. | |
| 114 | Record the average wet and dry bulb temperatures, heat exchanger temperature and barometric pressure on CVS data sheet (707-01). | $W_B$, °F<br>$D_B$, °F<br>$T_{IN}$,°F<br>Baro. Pressure<br>Baro. Hg |
| 115 | Record CVS hours, Horsepower and analyzer train number. | Hours, CVS<br>Hp-indicated<br>train number. |
| 116 | Prepare for next test. | |

## 9.0 DATA INPUT

9.1 Check form 707-01 (CVS data sheet) and assure that all required data has been filled in.

9.2 Assure that numerical deflections of HC, CO, $CO_2$ and $NO_x$ have been recorded on form 707-02 (Analyzer read-out) for each of the three phases of the FTP.

9.3 The Certification Branch representative and the Manufacturer's representative will inspect the CVS data sheet, driver's trace and CVS temp. trace. They will then sign CVS data sheet as valid or invalid.

9.4 Data Validation will complete form 707-01 and submit to Data Branch.

## 10.0 DATA ANALYSIS

10.1 Data analysis is performed by the SAQF:NEWCVS program.

10.2 Analysis is performed on Drivers Trace as stated in section 12 of procedure #TP-706.

10.3 Analysis of all other supporting data is performed by Data Validation.

## 11.0 DATA OUTPUT

11.1 Following completion of the hot soak evap. all of the following information is entered into the vehicle test file.

- CVS Data sheet form #707-01
- Diurnal temp. trace
- Analyzer trace
- Drivers trace
- CVS temp. trace
- 702-01, DRIVER'S PRECONDITIONING REPORT
- 705-01, VEHICLE TEST AND EVAPORATIVE DATA

11.2 Final copies of CVS data sheet and composite gram per mile results will go to the Certification Branch and the Manufacturer's representative.

## 12.0 ACCEPTANCE CRITERIA

12.1 Driver's trace must be within limits stated in section 12.0 of procedure #TP-706.

12.2 CVS temperature trace must be within ±10°F of set point for the entire test.

12.3 Manufacturer's representative must accept preliminary results as valid.

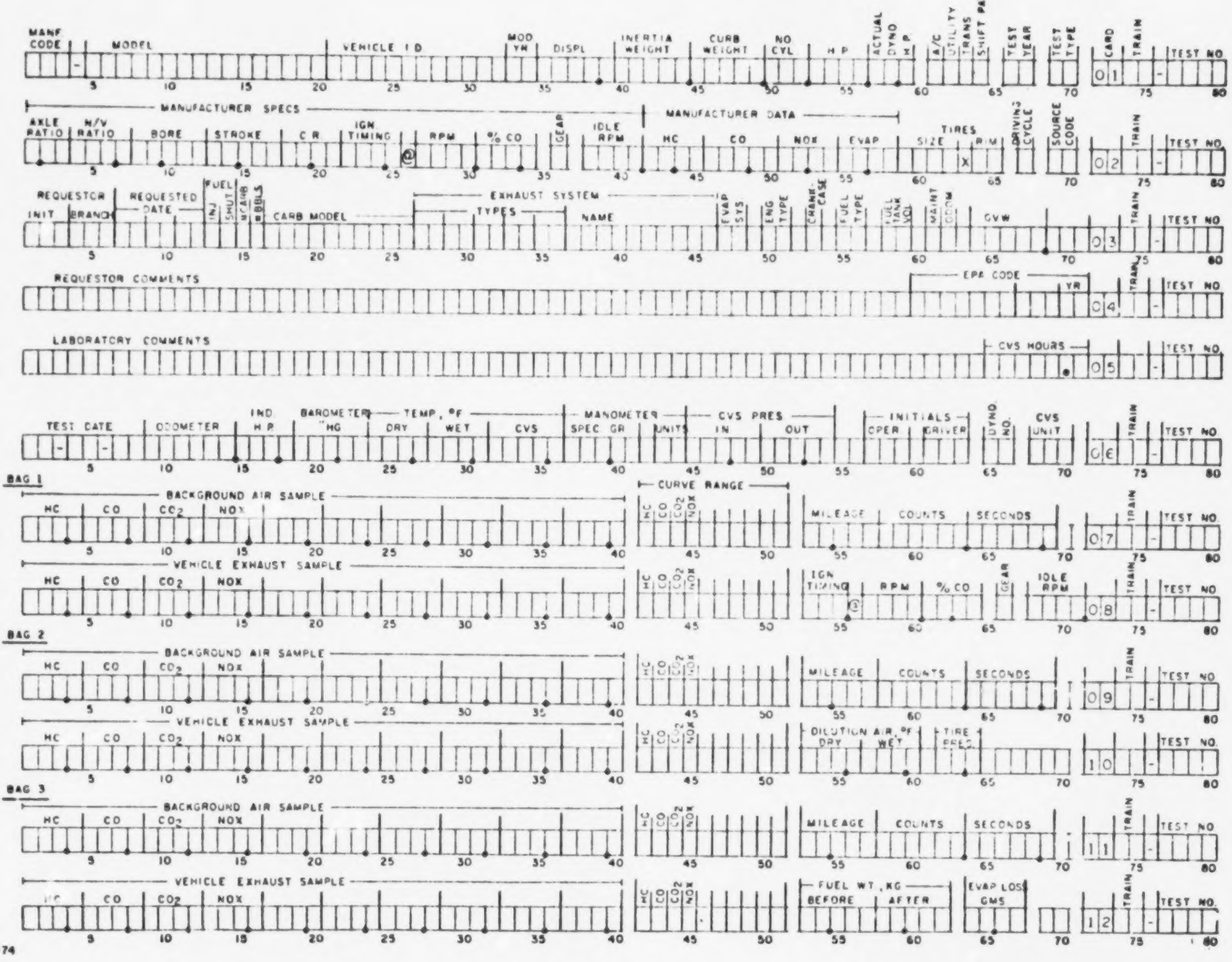
12.4 Analyzer post calibration must be within ±2 divisions of the initial span point.

## 13.0 QUALITY PROVISIONS

13.1 Check tests results on an "audit" basis to assure acceptance criteria has been met.

13.2 Initiate corrective action if "out of spec" conditions are discovered. (i.e., Production Control will reschedule vehicle)

# CONSTANT VOLUME SAMPLER (CVS) DATA SHEET



MANF CODE | MODEL | VEHICLE I D | MOD YR | DISPL | INERTIA WEIGHT | CURB WEIGHT | NO CYL | H P | ACTUAL DYNO H P | A/C | UTILITY | TRANS | SHIFT PAT | TEST YEAR | TEST TYPE | CARD 01 | TRAIN | TEST NO

MANUFACTURER SPECS: AXLE RATIO | N/V RATIO | BORE | STROKE | C R | IGN TIMING @ | RPM | % CO | GEAR | IDLE RPM — MANUFACTURER DATA: HC | CO | NOX | EVAP — TIRES: SIZE X RIM | DRIVING CYCLE | SOURCE CODE | 02 | TRAIN | TEST NO

REQUESTOR: INIT | BRANCH | REQUESTED DATE | FUEL: INJ | SHUT | #CARB | #BBLS | CARB MODEL | EXHAUST SYSTEM: TYPES | NAME | EVAP SYS | ENG TYPE | CRANK-CASE | FUEL TYPE | FUEL TANK VOL | MAINT | ODOM | GVW | 03 | TRAIN | TEST NO

REQUESTOR COMMENTS | EPA CODE: YR | 04 | TRAIN | TEST NO

LABORATORY COMMENTS | CVS HOURS | 05 | TEST NO

TEST DATE | ODOMETER | IND. H P | BAROMETER "HG | TEMP, °F: DRY | WET | CVS | MANOMETER: SPEC GR | UNITS | CVS PRES: IN | OUT | INITIALS: OPER | DRIVER | DYNO NO. | CVS UNIT | 06 | TRAIN | TEST NO

**BAG 1**

BACKGROUND AIR SAMPLE: HC | CO | CO2 | NOX | CURVE RANGE: HC | CO | CO2 | NOX | MILEAGE | COUNTS | SECONDS | 07 | TRAIN | TEST NO

VEHICLE EXHAUST SAMPLE: HC | CO | CO2 | NOX | HC | CO | CO2 | NOX | IGN TIMING @ | RPM | % CO | GEAR | IDLE RPM | 08 | TRAIN | TEST NO

**BAG 2**

BACKGROUND AIR SAMPLE: HC | CO | CO2 | NOX | HC | CO | CO2 | NOX | MILEAGE | COUNTS | SECONDS | 09 | TRAIN | TEST NO

VEHICLE EXHAUST SAMPLE: HC | CO | CO2 | NOX | HC | CO | CO2 | NOX | DILUTION AIR, °F: DRY | WET | TIRE PRES. | 10 | TEST NO.

**BAG 3**

BACKGROUND AIR SAMPLE: HC | CO | CO2 | NOX | HC | CO | CO2 | NOX | MILEAGE | COUNTS | SECONDS | 11 | TRAIN | TEST NO

VEHICLE EXHAUST SAMPLE: HC | CO | CO2 | NOX | HC | CO | CO2 | NOX | FUEL WT, KG: BEFORE | AFTER | EVAP LOSS GMS | 12 | TRAIN | TEST NO.

04-10-74

Form 707-01

### CARD 1

MANF CODE (COLS 1-3)

| CODE | EQUIVALENCE |
|---|---|
| 010 | AMERICAN MOTORS |
| 021 | (CHRYS) CHRYSLER |
| 022 | (CHRYS) DODGE |
| 023 | (CHRYS) PLYMOUTH |
| 031 | (FO MO CO) FORD |
| 032 | (FO MO CO) LINCOLN |
| 033 | (FO MO CO) MERCURY |
| 041 | (GM) BUICK |
| 042 | (GM) CADILLAC |
| 043 | (GM) CHEVROLET |
| 044 | (GM) OLDSMOBILE |
| 045 | (GM) PONTIAC |
| 046 | (GM) GMC |
| 047 | (GM) DETROIT DIESEL |
| 050 | ABARTH |
| 060 | A C CARS |
| 064 | AICHI |
| 070 | ASTON MARTIN |
| 080 | AUTO CAR |
| 085 | AUTO SPORT |
| 090 | ALFA ROMEO |
| 095 | AM GENERAL |
| 100 | AVANTI |
| 105 | AUBURN |
| 110 | AUSTIN MORRIS (BLMC) |
| 120 | BMW |
| 125 | BOLWELL |
| 130 | BRISTOL |
| 135 | BRICKLIN |
| 140 | CHECKER |
| 150 | CITROEN |
| 160 | COMMER |
| 170 | SAMCO (CORD) |
| 175 | DACIA (ARO) |
| 180 | DAF |
| 190 | DAIHATSU |
| 200 | MERCEDES BENZ |
| 205 | DE TOMASO |
| 210 | DUAL GHAI |
| 215 | DYNA TRUCK |
| 220 | FERRARI |
| 230 | FIAT |
| 240 | FORD OF ENGLAND |
| 245 | FORD OF GERMANY |
| 250 | HINO |
| 255 | HARLEY-DAVIDSON |
| 260 | HONDA |
| 270 | IHC |
| 280 | ISO |
| 290 | ISUZU |
| 300 | JAGUAR (BLMC) |
| 310 | JENSEN |
| 320 | JOHN FITCH |
| 330 | JEEP (KAISER) |
| 340 | LANCIA |
| 350 | LOTUS |
| 360 | MASERATI |
| 365 | MOHS |
| 370 | MORGAN |
| 380 | NISSAN |
| 390 | NSU |
| 400 | OPEL |
| 405 | PANTHER |
| 410 | PEUGEOT |
| 420 | PORSCHE |
| 430 | RENAULT |
| 440 | ROLLS-ROYCE |
| 450 | ROOTES |
| 460 | ROVER (BLMC) |
| 470 | SAAB |
| 480 | SHELBY |
| 490 | MITSUBISHI |
| 495 | SIAIRA |
| 500 | SIMCA |
| 510 | SKODA |
| 520 | SS AUTOMOBILE |
| 530 | TRIUMPH (BLMC) |
| 535 | STUTZ |
| 540 | SUZUKI |
| 550 | TORINO |
| 560 | TOYO KOGYO |
| 570 | TOYOTA |
| 580 | VAUXHALL |
| 590 | VOLKSWAGEN |
| 600 | VOLVO |
| 605 | WHITE |
| 610 | YENKO |
| 615 | YAMAHA |
| 620 | TVR |
| 630 | SUSPENSIONS INT (OMEGA) |
| 640 | AUDI |
| 650 | MURENA MOTORS |
| 660 | FUJI HEAVY IND |
| 670 | MONTEVERDI |
| 680 | INTERMECCANICA (ITALIA) |
| 690 | LAMBORGHINI |
| 700 | MARCOS |
| 710 | ARMY |
| 720 | WINNEBAGO |
| 725 | ALLIS CHALMERS |
| 730 | CATERPILLAR |
| 740 | CUMMINS |
| 750 | HERCULES |
| 760 | MACK |
| 770 | PERKINS |
| 780 | SCANIA-VABIS |
| 790 | GLASSIC |
| 800 | TELEDYNE CONTINENTAL |
| 810 | CASE |
| 820 | DIAMOND REO |
| 830 | HIGHWAY PRODUCTS,INC |
| 999 | EXPERIMENTAL |

AIR CONDITIONING (COL 61)

| | |
|---|---|
| 1 | WITH |
| 2 | WITHOUT |

UTILITY VEHICLE (COL 62)

| | |
|---|---|
| 1 | YES |
| 2 | NO |

TRANSMISSION (COL 63)

| | |
|---|---|
| 1 | AUTO |
| 2 | 3-SPEED |
| 3 | 4-SPEED |
| 4 | 5-SPEED |
| 5 | SEMI-AUTOMATIC |

SHIFT PATTERN (COL 64)

| | |
|---|---|
| 1 | STANDARD |
| 2 | OPTIONAL |

TEST TYPE (COLS 69-70)

| | |
|---|---|
| 00 | VOID |
| 01 | CERT (EMISSION DATA) |
| 02 | CERT (DURABILITY) |
| 03 | CERT (CORRELATION) |
| 04 | SURVEILLANCE |
| 05 | EXPERIMENTAL |
| 06 | FIELD SURVEILLANCE |
| 07 | PARTICULATES |
| 08 | OTHER |
| 09 | CVS CORRELATION |
| 10 | RESEARCH |
| 11 | CORRELATION (LAB) |
| 12 | CERT (RUNNING CHANGE) |

TRAIN (COLS 74-75)

| | |
|---|---|
| 1-97 | AEGAS |
| 98 | PARTICULATES |
| 99 | PROP SAMPLER |

### CARD 2

DRIVING CYCLE (COL 67)

| | |
|---|---|
| 1 | 7-MODE |
| 2 | LA-4 |
| 3 | LA-4 S3 |
| 4 | ANN ARBOR |
| 5 | LA-4 S4 |
| 6 | 9 X 7 MODE |
| 7 | STEADY STATE |
| 8 | OTHER |

SOURCE CODE (COLS 69-70)

| | |
|---|---|
| 01 | MANUFACTURER |
| 02 | HERTZ DETROIT |
| 03 | HERTZ L.A. |
| 04 | AVIS |
| 05 | AIRWAYS CORP L.A. |
| 06 | ALPH CORP L.A. |
| 07 | GSA L.A. |
| 08 | PO DEPT DETROIT |
| 09 | PO DEPT L.A. |
| 10 | L.A. COUNTY VEH |
| 11 | STATE OF CALIFORNIA |
| 12 | BORROWED FROM CORPS |
| 13 | AMERICAN RACEWAYS, INC |
| 14 | DEALER USED CARS |
| 15 | EPA |
| 16 | GSA |
| 17 | MILITARY |
| 18 | PRIVATE OWNER |
| 19 | OTHER |

### CARD 3

FUEL INJECTION (COL 13)

| | |
|---|---|
| 1 | YES |
| 2 | NO |

FUEL SHUTOFF (COL 14)

| | |
|---|---|
| 1 | YES |
| 2 | NO |

EXHAUST SYSTEM TYPE (COLS 27-28), (COLS 29-30),(COLS 31-32), (COLS 33-34) AND (COLS 35-36)

| | |
|---|---|
| 01 | AIR INJECTION |
| 02 | ENGINE MOD |
| 03 | FUEL INJECTION |
| 04 | OTHER |
| 05 | THERMAL REACTOR |
| 06 | CATALYTIC REACTOR |
| 07 | TURBOCHARGER |
| 08 | EXHAUST RECYCLE |
| 09 | NONE |

EVAP SYSTEM TYPE (COLS 47-48)

| | |
|---|---|
| 01 | CRANKCASE |
| 02 | CANISTER |
| 03 | TANK |
| 04 | NONE |

ENGINE TYPE (COLS 50-51)

| | |
|---|---|
| 01 | I-BLOCK |
| 02 | V-BLOCK |
| 03 | ROTARY |
| 04 | OPPOSED |
| 05 | TURBINE |
| 06 | EX (STEAM) |
| 07 | EX (FREON) |
| 08 | DIESEL |
| 09 | STIRLING |
| 10 | ELECTRIC |
| 11 | STRATIFIED |

CRANKCASE SYSTEM TYPE (COL 53)

| | |
|---|---|
| 1 | CLOSED |
| 2 | OTHER |

FUEL TYPE (COLS 55-56)

| | |
|---|---|
| 01 | INDOLENE 30 |
| 02 | COMMERCIAL LEADED |
| 03 | LPG |
| 04 | PROPANE |
| 05 | OTHER |
| 06 | IND UNLEADED, 91 OCT |
| 07 | IND UNLEADED, 100 OCT |
| 08 | #1 FUEL OIL |
| 09 | #2 FUEL OIL |
| 10 | NATURAL GAS |
| 11 | ALCOHOL |
| 12 | INDOLENE 10 |
| 13 | INDOLENE 20 |
| 14 | JP-4 |
| 15 | KEROSENE |
| 16 | COMMERCIAL UNLEADED |

MAINTENANCE CODE (COL 61)

| | |
|---|---|
| 1 | BEFORE |
| 2 | AFTER |
| 3 | NORMAL |

ODOMETER CODE (COL 62)

| | |
|---|---|
| 1 | MILES |
| 2 | KMS |

### CARD 6

MANOMETER UNITS (COLS 43-44)

| | |
|---|---|
| IN | INCHES |
| CM | CENTIMETERS |
| MM | MILLIMETERS |

Form 707-01 (cont.)

# ANALYZER TEST READ-OUT

TEST NO. ________ MFG ________________________ DATE ________

| BAG | HC | R | CO | R | $CO_2$ | R | NOx | R | |
|---|---|---|---|---|---|---|---|---|---|
| B/G 1 | | | | | | | | | |
| SAM. 3 | | | | | | | | | |
| B/G 2 | | | | | | | | | |
| SAM. 4 | | | | | | | | | |
| B/G 1 | | | | | | | | | |
| SAM 3 | | | | | | | | | |

OPERATOR REMARKS: ________________________

TEST NO. ________ MFG ________________________ DATE ________

| BAG | HC | R | CO | R | $CO_2$ | R | NOx | R | |
|---|---|---|---|---|---|---|---|---|---|
| B/G 1. | | | | | | | | | |
| SAM. 3 | | | | | | | | | |
| B/G 2 | | | | | | | | | |
| SAM 4 | | | | | | | | | |
| B/G 1 | | | | | | | | | |
| SAM 3 | | | | | | | | | |

OPERATOR REMARKS: ________________________

```
TEST #  16-7167                        1975 MSRCP CONSTANT-VOLUME SAMPLER RESULTS
                                                                                     PROCESSED:  14:38:43  JAN  3, 1975
 MFG.                                        MOD.            INERTIA   CURB      NO.           ACTUAL     A
 CODE     MODEL               VEHICLE I.D.   YR     DISPL.   WEIGHT    WEIGHT    CYL.   H.P.   DYNO.H.P.  C   UTL TRANS S.PAT.  TEST  TEST
 999  TCS CRICKET             776-DUZ      , 72     141.0    2500      0         4      0      0.0        2   2    1     1       YEAR  TYPE
                                                                                                                                  75    5
 AXLE    N/V                                 MANUFACTURE SPECS.                  IDLE/-----MANUFACTURE DATA---------/ TIRES     DRIVE   SOURCE
 RATIO   RATIO   BORE    STROKE    C.R.   TIMING    RPM    % CO GEAR    RPM    HC      CO      NOX     EVAP  SIZE  RIM    CYCLE   CODE
 0.0     0.0     0.0     0.0       0.0    0.0       0.     0.0          1.     0.0     0.0     0.0     0.0                  0       0

 REQUESTOR               FUEL                                    EXHAUST SYSTEM     EVAP  EGN   CRANK  FUEL  FUEL
 INIT. BRANCH  DATE   INJ. SHUT. #CARB #BBLS CARB MODEL         TYPES    NAME      SYS.  TYPE   CASE  TYPE  TANK  MAINT  ODOM   GVW
               0- 0- 0  0     0      0     0                    0 0 0 0 0           0     0      0     7     0     0      0      0

 REQUESTOR COMMENTS  :                        *****UNOFFICIAL PRELIMINARY*****
 LABORATORY COMMENTS :                        ***********RESULTS***********           ENGINE FAMILY : 0            00
                                                                                       CVS HOURS :
                       IND.     BARO  /----TEMP.,OF--------/----MANOMETER---/-----CVS PRES.----/---INITIALS---/  DYNO. CVS
 TEST DATE  ODOMETER   H.P.     MHG      DRY    WET     CVS    SPEC.GR. UNITS     IN      OUT      OPER.  DRIVER    NO.  UNIT
 1- 3-75      6113.    6.2      28.86    76.0   57.0   100.0    1.75    IN       24.65   17.45     CFF    TAT       08   7C
                          DILUTION AIR    0.0    0.0

  CUBIC FT     CALCULATED     NOX         IGN                               IDLE    EVAP. LOSS   TIRE
  PER REV.        RPM        FACTOR      TIMING     RPM    % CO    GEAR     RPM       GRAMS      PRES.
  0.27034        1466.       0.8593       00         0.    0.0      N        0.         .         45.0

BAG 1    3.590 MILES   12388. COUNTS    2710.2 CU. FT.                            D/FACTOR=13.829
              EXHAUST SAMPLE            BACKGROUND SAMPLE          CORRECTED           MASS EMISSIONS
           RANGE   METER     CONC.   RANGE   METER   CONC.    CONCENTRATIONS      GMS        GMS/MI        MPG1
  HC-FID     4     41.6     125.36     4      1.4     4.14      121.52 PPM        5.38        1.50
  CO         5     16.9      43.79     5      0.3     0.85       43.00 PPM        3.84        1.07
  CO2        2     35.4       0.952    2      1.5     0.041       0.914 %      1284.88      357.90          24.4
  NOX CHEM   4     37.3      37.30     4      0.4     0.40       36.93 PPM        4.66        1.30

BAG 2    3.910 MILES   21122. COUNTS    4621.1 CU. FT.   1376.0 SECONDS  D/FACTOR=22.716 ACT RPM= 1461.2 RPM RATIO(C/A)=0.9957
              EXHAUST SAMPLE            BACKGROUND SAMPLE          CORRECTED           MASS EMISSIONS
           RANGE   METER     CONC.   RANGE   METER   CONC.    CONCENTRATIONS      GMS        GMS/MI        MPG1
  HC-FID     4     19.2      57.31     4      1.5     4.43       53.07 PPM        4.00        1.02
  CO         3      6.3       2.80     3      0.1     0.04        2.76 PPM        0.42        0.11
  CO2        2     22.4       0.584    2      1.3     0.035       0.550 %      1318.27      337.15          26.1
  NOX CHEM   3     39.8      19.90     3      0.8     0.40       19.52 PPM        4.20        1.07

BAG 3    3.590 MILES   13099. COUNTS    2865.8 CU. FT.    538.1 SECONDS  D/FACTOR=15.908 ACT RPM= 1460.6 RPM RATIO(C/A)=0.9952
              EXHAUST SAMPLE            BACKGROUND SAMPLE          CORRECTED           MASS EMISSIONS
           RANGE   METER     CONC.   RANGE   METER   CONC.    CONCENTRATIONS      GMS        GMS/MI        MPG1
  HC-FID     4     33.2      99.74     4      2.1     6.21       93.92 PPM        4.40        1.22
  CO         3     37.1      18.06     3      0.0     0.0        18.06 PPM        1.71        0.48
  CO2        2     31.3       0.831    2      1.4     0.038       0.795 %      1181.30      329.05          26.6
  NOX CHEM   4     34.4      34.40     4      0.4     0.40       34.03 PPM        4.54        1.26

WEIGHTED VALUES      HC       CO       CO2       NOX       HE                    75 FTP1   72-4 FTP1   75 WEIGHTED1   FUEL-WEIGHT1
  GRAMS/MILE        1.18     0.406     339.      1.17      0.                      MPG       MPG          MPG            MPG
                                                                                   25.6      25.2         25.8           0.0
```

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best available copy.

| | | |
|---|---|---|
| **EPA TEST PROCEDURE** | Number TP-708 | Page 1 of 5 |

| | |
|---|---|
| SUBJECT<br>HOT SOAK EVAPORATIVE | |
| Reference FEDERAL REGISTER, VOL. 39, NO. 101, MAY 23, 1974, Sec. 95-075-13 & 21 | Data Form No.<br>705-01, Sec. IV |
| Responsible Organization<br>TEST OPERATIONS | Computer Program<br>SEE COMMENTS |
| Test Witness/Review<br>MANUFACTURER'S REPRESENTATIVE, DATA VALIDATION | Performance Interval<br>PER VEHICLE |
| Type of Test Report<br>DATA FORM OUT-PUT | Supersedes<br>NEW |
| Report Distribution MANUFACTURER, QUALITY ASSURANCE, DATA VALIDATION, CERTIFICATION BRANCH | Superseded by |

REMARKS/COMMENTS

1.0 EVAPORATIVE DATA ANALYSIS IS ACCOMPLISHED BY SAQF:NEWCVS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

| REVISIONS: | HOT SOAK EVAPORATIVE<br>**TEST PROCEDURE** | PROCEDURE NO.<br>TP-708<br>PAGE 2 OF 5 |
|---|---|---|

1.0 PURPOSE

To measure and quantify hydrocarbon evaporative losses after vehicle has been driven and is parked in soak area.

2.0 TEST ARTICLE DESCRIPTION

2.1 Certification Test Vehicle.

3.0 REFERENCES

3.1 *Federal Register*, Vol. 39, No. 101, May 23, 1974, Sec. 85.075-13, 85.075-21.

3.2 EPA Training Manual, "Light Duty Certification Testing Procedures."

4.0 REQUIRED EQUIPMENT

4.1 Drying tubes - 3/4 in. ID, tubular, transparent

4.2 Desiccant, 8 mesh

4.3 Collection tubing, stainless or aluminum, 5/16 ID.

4.4 PVC tubing, 5/16 ID.

4.5 Hosecock clamps. rubber plugs, aluminum foil, tape

4.6 Balance - accuracy ±.075 grams

4.7 Temperature recorder, multi-channel, range 50° to 100°F, accuracy ±1°F

4.8 Type "J" thermocouples, iron-constantine

4.9 Carbon traps, activated carbon, 300 ±25 ml, capacity 150 gms activated carbon

5.0 PRECAUTIONS

5.1 Do not place canisters on the floor, or suspend from collection tubing. DO NOT KINK LINES.

5.2 Close the hood as soon as possible after plumbing and collection canisters have been reinstalled.

5.3 Caution should be exercised when connecting and removing canister to prevent vapor loss.

| REVISIONS: | HOT SOAK EVAPORATIVE | PROCEDURE NO. TP-708 |
|---|---|---|
| | **TEST PROCEDURE** | PAGE 3 OF 5 |

## 6.0 VISUAL INSPECTION

6.1 Inspect all plumbing and electrical connections.

## 7.0 TEST ARTICLE PREPARATION

7.1 Re-seal all orifices and vents as described in section 7.0 of procedure TP-705.

7.2 Plug exhaust pipe.

7.3 Re-seal fuel cap area.

7.4 Reconnect temperature recorder and thermocouple lead -channel 2 for ambient temperature.

7.5 Check the above items off in section IV of form #705-01.

| REVISIONS: | HOT SOAK EVAPORATIVE<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-708<br>**PAGE** 4 **OF** 5 |
|---|---|---|

## 8.0 TEST PROCEDURE

The following steps are necessary to assure proper collection of the hot soak evaporative losses. As each step is completed check off on form 705-01, sec. IV.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Immediately after the engine is turned off reconnect the carbon canisters to the required trap points. Ref: TP-705.<br>NOTE: Same canisters and placement as in diurnal evap. Remove clamps. | |
| 103 | Start one hour soak and record start time. | Start time |
| 104 | Record ambient temperature at beginning of soak. | Start temp. |
| 105 | Check ambient temperature at 15 min. intervals to insure "out of spec" conditions do not occur. | Check temp. |
| 106 | At the end of the one hour soak record end time and final ambient temperature. | End time<br>End temp. |
| 107 | Shut off temperature recorder | Shut off recorder |
| 108 | Reclamp canisters and remove. | |
| 109 | Weigh the canisters with hose-cock clamp connected and record on form 705-02 in hot soak wt. block. | Hot weight |

## 9.0 DATA INPUT

9.1 Complete section IV of form 705-01 (Vehicle Test and Evap.) and sign/date at the bottom of form.

9.2 Insure that final hot weight is recorded on form 705-02 (Evap. Emission Data).

9.3 Fold temperature trace and turn in to Data Validation with the abovementioned forms.

## 10.0 DATA ANALYSIS

10.1 Subtract the "initial weight" for each canister from the "hot weight" and add the "evap. emissions" of each together to get the "Total Evap. Emissions."

## 11.0 DATA OUTPUT

11.1 Total Evaporative Emissions from the diurnal and hot soak tests.

11.2 Record on data sheet 707-01.

## 12.0 ACCEPTANCE CRITERIA

12.1 The soak time for evap. collection is not to exceed 1 hour.

12.2 The ambient temperature must remain between 76°F and 86°F during collection period.

12.3 The collection procedure must have been performed correctly.

## 13.0 QUALITY PROVISIONS

13.1 Form #705-01 has a built in Quality check in Section IV. Each step performed is checked off by the technician and then checked and signed off by a witness, thus an audit is performed at the site of the test.

13.2 The soak time and temperature should be audited by the Q.A. department to assure the specific limits have not been exceeded.

13.3 If "out of spec" conditions are discovered a request for corrective action should be submitted to Test Operations.

# VEHICLE TEST AND EVAPORATIVE DATA

Vehicle Mfgr.____________________ No._______________

Inertia Wt.________ HP________ A/C________ Test #__________

## I. HEAT BUILD

| | TECH | CTA |
|---|---|---|
| A. Drain fuel | ☐ | ☐ |
| B. Plumb air cleaner | ☐ | ☐ |
| C. Plumb canister | ☐ | ☐ |
| D. Plumb bowl vent (if required) | ☐ | ☐ |
| E. Trap gas cap (if required) | ☐ | ☐ |
| F. Seal orifices/vents | ☐ | ☐ |
| G. Install carbon traps (record on data sheet) | ☐ | ☐ |
| H. Hook-up temperature recorder | ☐ | ☐ |
| I. Hook-up thermocouple leads | ☐ | ☐ |
| J. Install heat blanket | ☐ | ☐ |
| K. Plug in fuel tank heater (when used) | ☐ | ☐ |
| L. Refuel vehicle - 40% of tank capacity | ☐ | ☐ |

Tech. Sig.________________ Witness Sig.________________

| | TECH | CTA |
|---|---|---|
| M. Replace fuel cap, plug exhaust pipe(s) Unclamp canister | ☐ | ☐ |

| Heat Build Progress | Fuel Temp. Lead No. 1 | Fuel Temp. Lead No. 4 | Ambient Temp. |
|---|---|---|---|
| 0-Min. | | | |
| 15-Min. | | | |
| 30-Min. | | | |
| 45-Min. | | | |
| 60-Min. | | | |

## II. DYNAMOMETER WARM-UP/SET

A. Drive non-test vehicle onto dyno B. Hook-up vehicle as for Hot LA-4
C. Set inertia______lbs.@______H.P. D. Drive @50mph steady state
E. Remove vehicle from dyno

I. Tech. Sig.____________________ Date__________

II. Tech. Sig.____________________ Date__________

FORM 705-01

## III. MASS EXHAUST EMISSIONS TEST

A. Check Varian Paper-OK ☐ Pen-OK ☐ Ink-OK ☐ Zero-OK ☐

B. Cooling fan in place OK ☐ Release dyno brake-OK ☐

C. Hook up Chock blocks-OK ☐ Cable winch ☐ Exhaust ☐

D. Temp. recorder Connect thermocouple leads ☐ Start recorder ☐

E. CVS Check fan operation ☐ Bags-OK ☐ Rev. Ctr. Zero ☐
Leak check-OK ☐ CVS Temp-OK ☐
Cell temp-OK ☐ Return to sample ☐

F. Drive test trace ☐ Check tire pressure (45 PSI) ☐

G. Remove vehicle to Soak Area ☐

---

| IV. HOT SOAK EVAPORATIVE EMISSIONS TEST | TECH | CTA |
|---|---|---|
| A. Reseal orifices/vents | ☐ | ☐ |
| B. Reconnect carbon canisters and unclamp | ☐ | ☐ |
| C. Reconnect temp. recorder and thermocouple leads | ☐ | ☐ |
| D. Check gas cap | ☐ | ☐ |
| E. Plug exhaust pipe(s) | ☐ | ☐ |
| F. 1-hour soak Start time______ End______ | ☐ | ☐ |
| G. Start amb. temp.______ End amp. temp.______ | ☐ | ☐ |
| H. Check ambient temp. at 15-min. intervals | ☐ | ☐ |
| I. End of hot soak - reclamp canisters and remove | ☐ | ☐ |
| J. Shut-off temp. recorder | ☐ | ☐ |
| K. Weigh canisters and record on data sheet | ☐ | ☐ |

---

## V. DE-PREP AND VEHICLE REMOVAL

| | | |
|---|---|---|
| A. Remove all collection tubing, exhaust pipe plug(s), orifice/vent plugs, tape, foil, etc. | ☐ | ☐ |
| B. Disconnect temp. recorder & thermocouple leads | ☐ | ☐ |
| C. Return engine to Mfgr's running configuration | ☐ | ☐ |
| D. Move vehicle to East lot - keys to Prod. Contr. | ☐ | ☐ |
| E. "VOID" or "FAILED" vehicles - check with Team Leader for disposition | | |
| F. Leave as is, if acceptable for HWFET | | |

III. Tech. Sig.______________________________ Date____________

IV. Tech. Sig.______________________________ Date____________

V. Tech. Sig.______________________________ Date____________

EVAPORATIVE EMISSION WEIGHING DATA

TEST NO.____________________

DATE____________________

MAKE OF CAR____________________

| | | | | |
|---|---|---|---|---|
| CANISTER NO. | | | | |
| CANISTER LOCATION | | | | |
| HOT SOAK WEIGHT | | | | |
| INITIAL WEIGHT | | | | |
| EVAP. EMISSIONS | | | | |

TOTAL EVAP. EMISSIONS____________________

FORM 705-02

**EPA TEST PROCEDURE**

Number TP-709

Page 1 of 4

| | |
|---|---|
| SUBJECT<br>VEHICLE DE-PREP AND REMOVAL | |
| Reference<br>EPA, ANN ARBOR, DRAFT "LIGHT DUTY TEST OPERATIONS" | Data Form No.<br>705-01 SEC.V, 709-01 |
| Responsible Organization<br>TEST OPERATIONS | Computer Program<br>NONE |
| Test Witness/Review<br>TECHNICIAN/CHECKER, TEAM LEADER | Performance Interval<br>PER VEHICLE |
| Type of Test Report<br>DATA FORM OUT-PUT | Supersedes<br>NEW |
| Report Distribution<br>QUALITY ASSURANCE, DATA VALIDATION, TEST FILE | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Chief | | |
| Lab Branch | Test Operations Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

| REVISIONS: | VEHICLE DE-PREP AND REMOVAL<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-709<br>**PAGE** 2 **OF** 4 |
|---|---|---|

1.0 PURPOSE

To restore vehicle to Manufacturer's running condition following the FTP and Evap. tests and assure correct disposition of the vehicle.

2.0 TEST ARTICLE DESCRIPTION

2.1 Manufacturer's certification vehicle.

3.0 REFERENCES

3.1 EPA, Ann Arbor, Draft "Light Duty Test Operations."

4.0 REQUIRED EQUIPMENT

NONE.

5.0 PRECAUTIONS

5.1 Care should be taken to assure that all equipment has been re-connected correctly.

6.0 VISUAL INSPECTION

6.1 Check for any collection equipment that may have been overlooked during removal.

7.0 TEST ARTICLE PREPARATION

NONE.

| | | |
|---|---|---|
| **REVISIONS:** | VEHICLE DE-PREP AND REMOVAL<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-709<br>**PAGE** 3 **OF** 4 |

8.0 TEST PROCEDURE

The following steps are required to assure proper de-prep removal of the test vehicle. Check off items in section V of form #705-01 as completed.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Remove the following articles from the vehicle:<br>o Collection tubing<br>o Exhaust plug (s)<br>o Orifice/vent plugs<br>o Tape | A. |
| 102 | Disconnect temperature recorder and thermocouples. | B. |
| 103 | Return to manufacturer's running configuration. | C. |
| 104A | If the test is acceptable, move vehicle to parking lot and return keys to Production Control. | D. |
| 104B | If the test is "void" or vehicle "fails" check with Team Leader for instructions. | E. |
| 104C | Leave vehicle in soak area if HWFET is to be run. | F. |

## 9.0 DATA INPUT

9.1 Section V of form #705-01 is completed and submitted to Data Analysis.

## 10.0 DATA ANALYSIS

None required.

## 11.0 DATA OUTPUT

11.1 Form is filed with the vehicle data with Data Validation.

## 12.0 ACCEPTANCE CRITERIA

12.1 Technician must sign form to verify tasks have been completed.

## 13.0 QUALITY PROVISIONS

13.1 A checker will witness all tasks completed by the technician, thereby performing an initial audit of the data sheet.

13.2 Final test disposition shall be indicated on the data sheet.

13.3 If the test was void, a failure report (Test Condition Report, form #709-01) shall accompany the test data sheet and the type of failure should be coded in the space provided.

# VEHICLE TEST AND EVAPORATIVE DATA

Vehicle Mfgr.____________________ No.________________

Inertia Wt.________ HP________ A/C________ Test #__________

---

## I. HEAT BUILD

| | TECH | CTA |
|---|---|---|
| A. Drain fuel | ☐ | ☐ |
| B. Plumb air cleaner | ☐ | ☐ |
| C. Plumb canister | ☐ | ☐ |
| D. Plumb bowl vent (if required) | ☐ | ☐ |
| E. Trap gas cap (if required) | ☐ | ☐ |
| F. Seal orifices/vents | ☐ | ☐ |
| G. Install carbon traps (record on data sheet) | ☐ | ☐ |
| H. Hook-up temperature recorder | ☐ | ☐ |
| I. Hook-up thermocouple leads | ☐ | ☐ |
| J. Install heat blanket | ☐ | ☐ |
| K. Plug in fuel tank heater (when used) | ☐ | ☐ |
| L. Refuel vehicle - 40% of tank capacity | ☐ | ☐ |

Tech. Sig.__________________ Witness Sig.__________________

M. Replace fuel cap, plug exhaust pipe(s) Unclamp canister ☐ ☐

| Heat Build Progress | Fuel Temp. Lead No. 1 | Fuel Temp. Lead No. 4 | Ambient Temp. |
|---|---|---|---|
| 0-Min. | | | |
| 15-Min. | | | |
| 30-Min. | | | |
| 45-Min. | | | |
| 60-Min. | | | |

---

## II. DYNAMOMETER WARM-UP/SET

A. Drive non-test vehicle onto dyno B. Hook-up vehicle as for Hot LA-
C. Set inertia______lbs.@______H.P. D. Drive @50mph steady state
E. Remove vehicle from dyno

I. Tech. Sig.________________________ Date____________

II. Tech. Sig.________________________ Date____________

FORM 705-01

## III. MASS EXHAUST EMISSIONS TEST

A. Check Varian Paper-OK ☐ Pen-OK ☐ Ink-OK ☐ Zero-OK ☐

B. Cooling fan in place OK ☐ Release dyno brake-OK ☐

C. Hook up Chock blocks-OK ☐ Cable winch ☐ Exhaust ☐

D. Temp. recorder Connect thermocouple leads ☐ Start recorder ☐

E. CVS Check fan operation ☐ Bags-OK ☐ Rev. Ctr. Zero ☐
Leak check-OK ☐ CVS Temp-OK ☐
Cell temp-OK ☐ Return to sample ☐

F. Drive test trace ☐ Check tire pressure (45 PSI) ☐

G. Remove vehicle to Soak Area ☐

---

## IV. HOT SOAK EVAPORATIVE EMISSIONS TEST

| | TECH | CTA |
|---|---|---|
| A. Reseal orifices/vents | ☐ | ☐ |
| B. Reconnect carbon canisters and unclamp | ☐ | ☐ |
| C. Reconnect temp. recorder and thermocouple leads | ☐ | ☐ |
| D. Check gas cap | ☐ | ☐ |
| E. Plug exhaust pipe(s) | ☐ | ☐ |
| F. 1-hour soak Start time______ End______ | ☐ | ☐ |
| G. Start amb. temp.______ End amp. temp.______ | ☐ | ☐ |
| H. Check ambient temp. at 15-min. intervals | ☐ | ☐ |
| I. End of hot soak - reclamp canisters and remove | ☐ | ☐ |
| J. Shut-off temp. recorder | ☐ | ☐ |
| K. Weigh canisters and record on data sheet | ☐ | ☐ |

---

## V. DE-PREP AND VEHICLE REMOVAL

| | | |
|---|---|---|
| A. Remove all collection tubing, exhaust pipe plug(s), orifice/vent plugs, tape, foil, etc. | ☐ | ☐ |
| B. Disconnect temp. recorder & thermocouple leads | ☐ | ☐ |
| C. Return engine to Mfgr's running configuration | ☐ | ☐ |
| D. Move vehicle to East lot - keys to Prod. Contr. | ☐ | ☐ |
| E. "VOID" or "FAILED" vehicles - check with Team Leader for disposition | ☐ | ☐ |
| F. Leave as is, if acceptable for HWFET | | |

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III. Tech. Sig.______________________________ Date______________

IV. Tech. Sig.______________________________ Date______________

V. Tech. Sig.______________________________ Date______________

# TEST CONDITION REPORT

Failure ____ Void ____ Retest Requested ____

Name ________________ Date Submitted ________________

Branch ____________ Section ____________ Extension ______

Test Type: ____ LD ____ MD ____ HD ____ Other

Manufacturer ____________ Identification Number ________

Date ________ Time ________ Operator ________________

Equipment Involved in Failure:

____ Analysis System ____ Recorder ____ Bags

____ HC ____ CO ____ NO ____ $CO_2$ ____ Temp.

____ CVS ____ Drivers Trace ____ FID

____ CVS Counter ____ Cold Start ____ Hot Start

____ Dynamometer ____ Other (Specify)

Failure Description ________________________________

____________________________________________________

____________________________________________________

____________________________________________________

Void Point ________________ Hours Lost ________
(Include Prep Time)

Corrective Action Taken ____________________________

____________________________________________________

____________________________________________________

____________________________________________________

cc: D. Clark
M. Davis
Jesse Metcalf
Team Leader

________________________
Signature

2/8/74

FORM 709-01

| | | |
|---|---|---|
| **EPA TEST PROCEDURE** | Number TP-710 | Page 1 of 4 |

| | |
|---|---|
| SUBJECT<br>HIGHWAY FUEL ECONOMY PRE-CONDITIONING | |
| Reference FEDERAL REGISTER, VOL.39, NO.200, OCT.15,1974-<br>APPENDIX "EPA REC PRAC FOR COND HIWAY FUEL ECON TESTS" | Data Form No.<br>710-01 |
| Responsible Organization<br>TEST OPERATION | Computer Program<br>NONE |
| Test Witness/Review<br>MANUFACTURER'S REPRESENTATIVE, TEAM LEADER | Performance Interval<br>PER VEH, AS REQ |
| Type of Test Report<br>DATA SHEET | Supersedes<br>NEW |
| Report Distribution<br>QUALITY ASSURANCE, CERT.BRANCH, DATA VALIDATION, TEST FILE | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Chief | | |
| Lab Branch | Test Operations Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

1.0 PURPOSE

To prepare vehicles for the 1975 Highway Fuel Economy Test.

2.0 TEST ARTICLE DESCRIPTION

2.1 Test vehicle designated for the HWFET.

3.0 REFERENCES

3.1 Federal Register, Vol. 39, No. 200, Oct. 15, 1974 - Appendix "EPA Recommended Practices for Conducting Highway Fuel Economy Tests"

4.0 REQUIRED EQUIPMENT

4.1 Chassis dynamometer and associated meters.

4.2 Driver's aid - Hewlett-Packard, Varian.

5.0 PRECAUTIONS

5.1 Insure proper fuel is used.

5.2 Inertia setting and horsepower and shift points (unless specified) are the SAME AS THE FTP.

6.0 VISUAL INSPECTION

6.1 Check the vehicle set-up.

7.0 TEST ARTICLE PREPARATION

7.1 Drive the vehicle from the soak area and onto the dynamometer.

7.2 Tie-down vehicle with winch cable(s), place fan 12 inches in front of grill and hook-up exhaust vent system.

| | | |
|---|---|---|
| **REVISIONS:** | HIGHWAY FUEL ECONOMY PRE-CONDITIONING<br>**TEST PROCEDURE** | **PROCEDURE NO.**<br>TP-710<br>**PAGE** 3 **OF** 4 |

8.0 TEST PROCEDURE

The following steps must be taken to assure the proper preparation of a test vehicle for the Highway Fuel Economy Test.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Drive vehicle from soak area immediately following the "Hot Soak Evap. Test." onto the dyno. Drive one-preconditioning HWFET. | |
| 102 | In the event the FTP and HWFET cannot be run back to back, precondition vehicle as follows: | |
| 102A | Less than 3 hours of soak (including 1 hour hot soak) Drive one preconditioning HWFET and one for data collection. Set horsepower prior to warm-up HWFET. | |
| 102B | Three to 24 hours of soak: Drive 5 minutes at 50 mph followed by one preconditioning HWFET and one for data collection. Set horsepower during the 50 mph cruise. | |
| 102C | Greater than 24 hours of soak or periods of outdoor storage: Run the "AMA" preconditioning route, an LA-4 dynamometer simulation, a preconditioning HWFET and one for data. Set horsepower prior to the LA-4. | |

| REVISIONS: | HIGHWAY FUEL ECONOMY PRE-CONDITIONING<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-710<br>**PAGE** 4 **OF** 4 |
|---|---|---|

## 9.0 DATA INPUT

9.1 Complete data form #710-01 to indicate Preconditioning was completed.

## 10.0 DATA ANALYSIS

None required.

## 11.0 DATA OUTPUT

11.1 Data form is entered into vehicle file.

## 12.0 ACCEPTANCE CRITERIA

12.1 Required preconditioning (see section 8.0) must be completed and documented prior to sample HWFET.

## 13.0 QUALITY CONTROL PROVISIONS

13.1 If the required preconditioning has not been performed submit a request for corrective action.

# HIGHWAY FUEL ECONOMY PRECONDITIONING
# CHECK SHEET

1. Check off the box corresponding to the type of HWFET preconditioning performed.

☐ Drive vehicle from soak area and immediately following the "Hot Soak Evap. Test" and onto the dyno. Drive one preconditioning HWFET.

In the event the FTP and HWFET cannot be run back to back, precondition vehicle as follows:

☐ Less than 3 hours of soak (including 1 hour hot soak): Drive one preconditioning HWFET and one for data collection. Set horsepower prior to warm-up HWFET.

☐ Three to 24 hours of soak: Drive 5 minutes at 50 mph followed by one preconditioning HWFET and one for data collection. Set horsepower during the 50 mph cruise.

☐ Greater than 24 hours of soak or periods of outdoor storage: Run the "AMA" preconditioning route, an LA-4 dynamometer simulation, a preconditioning HWFET, and one for data. Set horsepower prior to the LA-4.

Date: ____________________

Technician
and I.D. No. ____________________

Time: ____________________

Form 710-01

| **EPA TEST PROCEDURE** | Number TP-711 | Page 1 of 4 |
|---|---|---|

| | |
|---|---|
| SUBJECT<br>HIGHWAY FUEL ECONOMY DYNO TEST | |
| Reference<br>FEDERAL REGISTER, VOL. 39, NO.200, Oct. 15, 1974 - Appendix | Data Form No.<br>707-01 |
| Responsible Organization<br>TEST OPERATIONS | Computer Program<br>ANALYSIS; SAQF:NEWCVS |
| Test Witness/Review<br>MANUFACTURER"S REPRESENTATIVE, DATA VALIDATION | Performance Interval<br>PER VEHICLE AS REQ. |
| Type of Test Report<br>DATA SHEET | Supersedes<br>NEW |
| Report Distribution<br>QUALITY ASSURANCE, DATA VALIDATION, CERT. BRANCH, FILE | Superseded by |

REMARKS/COMMENTS

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Chief | | |
| Lab Branch | Test Operations Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

**REVISIONS:**

HIGHWAY FUEL ECONOMY DYNO TEST

**TEST PROCEDURE**

**PROCEDURE NO.** TP-711

**PAGE** 2 **OF** 4

1.0 PURPOSE

The Highway Fuel Economy Test is a nonmetropolitan driving cycle, 10.2 miles long with an average speed of 48.6 mph. A vehicle is driven on a dynamometer following the cycle and emissions are collected by the same means as the FTP.

2.0 TEST ARTICLE DESCRIPTION

2.1 Test vehicle designated for HWFET

3.0 REFERENCES

3.1 Federal Register, Vol. 39, No. 200, Oct. 15, 1974 - Appendix "EPA Recommended Practices for Conducting Highway Fuel Economy Tests."

4.0 REQUIRED EQUIPMENT

4.1 Constant Volume Sampler equipped to meet requirements in Federal Register, Sec. 85.075-20.

4.2 Chassis Dynamometer

- Clayton, Model ECE-50

4.3 Computer generated driver's aid

- Hewlett-Packard, Varian

4.4 Highway Fuel Economy driver's trace (2 cycles)

5.0 PRECAUTIONS

5.1 Insure test vehicle is aligned on dynamometer correctly and tied down.

5.2 It is extremely important that the horsepower/inertia settings used for the HWFET are the same as previously used for the FTP.

6.0 VISUAL INSPECTION

6.1 Insure fan and tail pipe connector(s) are in place.

6.2 Check bags for correct installation.

7.0 TEST ARTICLE PREPARATION

7.1 Follow procedures detailed in procedure TP-707

7.2 Check driver's aid for paper and ink.

Preceding page blank

| REVISIONS: | HIGHWAY FUEL ECONOMY DYNO TEST<br>**TEST PROCEDURE** | **PROCEDURE NO.** TP-711<br>**PAGE** 3 **OF** 4 |
|---|---|---|

8.0 TEST PROCEDURE

The Highway Fuel Economy data is collected as a result of the following procedural steps.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Following the preconditioning HWFET, the driver has 15 seconds to prepare for the actual sample period. | |
| 102 | Two seconds before the first acceleration the CVS counter button is depressed to start the sample period. | |
| 103 | The driver will drive the vehicle in the same manner as required for the FTP to insure "out of spec" conditions do not occur. | |
| 104 | Two seconds after the final decel to zero the rev. count button is depressed to end the sample period. | |
| 105 | The sample bags are delivered to the analyzer operator for analysis. | |

9.0 DATA INPUT

9.1 Fill out form #707-01 and sign off after test completion.

9.2 Driver will sign HWFET trace.

10.0 DATA ANALYSIS

10.1 Driver's trace should be checked for "out of spec." conditions.

11.0 DATA OUTPUT

11.1 Driver's trace and form #707-01 are submitted to Data Validation

12.0 ACCEPTANCE CRITERIA

12.1 The driver's trace is subject to the criteria of acceptance detailed in Section 12.0 of procedure 706. (Urban Dyno. FTP)

12.2 Sample period should be 765 ±2 seconds.

13.0 QUALITY CONTROL PROVISIONS

13.1 The Quality Control section should inspect the driver's trace to assure the acceptable limits stated in Section 12 have been followed.

13.2 If "out of limits" conditions are discovered, Quality Control should implement corrective action. (i.e., have Production Control reschedule vehicle for test.)

# CONSTANT VOLUME SAMPLER (CVS) DATA SHEET

MANF CODE | - | MODEL | VEHICLE I.D. | MOD YR | DISPL. | INERTIA WEIGHT | CURB WEIGHT | NO. CYL | H.P. | ACTUAL DYNO H.P. | A/C | UTILITY | TRANS | SHIFT PAT | TEST YEAR | TEST TYPE | CARD 01 | TRAIN | - | TEST NO

MANUFACTURER SPECS: AXLE RATIO | N/V RATIO | BORE | STROKE | C.R. | IGN TIMING | RPM | % CO | GEAR | IDLE RPM — MANUFACTURER DATA: HC | CO | NOx | EVAP — TIRES: SIZE | RIM | DRIVING CYCLE | SOURCE CODE | CARD 02 | TRAIN | - | TEST NO

REQUESTOR: INIT | BRANCH | REQUESTED DATE | FUEL | INLT | # CARB | # BBLS | CARB MODEL | EXHAUST SYSTEM: TYPES | NAME | EVAP SYS | ENG TYPE | CRANK-CASE | FUEL TYPE | [illegible] | MAINT ITEM | GVW | CARD 03 | TRAIN | - | TEST NO

REQUESTOR COMMENTS | EPA CODE | YR | CARD 04 | TRAIN | - | TEST NO

LABORATORY COMMENTS | CVS HOURS | CARD 05 | - | TEST NO

TEST DATE (- -) | ODOMETER | IND H.P. | BAROMETER "HG | TEMP, °F: DRY | WET | CVS | MANOMETER: SPEC GR | UNITS | CVS PRES: IN | OUT | INITIALS: OPER | DRIVER | DYNO NO. | CVS UNIT | CARD 06 | TRAIN | - | TEST NO

**BAG 1**

BACKGROUND AIR SAMPLE: HC | CO | $CO_2$ | NOx | CURVE RANGE: HC | CO | $CO_2$ | NOx | MILEAGE | COUNTS | SECONDS | CARD 07 | TRAIN | - | TEST NO

VEHICLE EXHAUST SAMPLE: HC | CO | $CO_2$ | NOx | HC | CO | $CO_2$ | NOx | IGN TIMING | RPM | % CO | GEAR | IDLE RPM | CARD 08 | TRAIN | - | TEST NO

**BAG 2**

BACKGROUND AIR SAMPLE: HC | CO | $CO_2$ | NOx | HC | CO | $CO_2$ | NOx | MILEAGE | COUNTS | SECONDS | CARD 09 | TRAIN | - | TEST NO

VEHICLE EXHAUST SAMPLE: HC | CO | $CO_2$ | NOx | HC | CO | $CO_2$ | NOx | DILUTION AIR, °F: DRY | WET | TIRE PRES. | CARD 10 | - | TEST NO

**BAG 3**

BACKGROUND AIR SAMPLE: HC | CO | $CO_2$ | NOx | HC | CO | $CO_2$ | NOx | MILEAGE | COUNTS | SECONDS | CARD 11 | TRAIN | - | TEST NO

VEHICLE EXHAUST SAMPLE: HC | CO | $CO_2$ | NOx | HC | CO | $CO_2$ | NOx | FUEL WT, KG: BEFORE | AFTER | EVAP LOSS GMS | CARD 12 | TRAIN | - | TEST NO

04-10-74

Form 707-01

**EPA TEST PROCEDURE**

Number TP-712

Page 1 of 1

SUBJECT

SAMPLE ANALYSIS FOR HWFET

Reference FEDERAL REGISTER, VOL. 39, NO. 200, Oct.15,1974 - APPENDIX, "EPA Rec Prac for Conducting Hiway Fuel Econ Test"

Data Form No. 707-01,02

Responsible Organization
TEST OPERATIONS

Computer Program
SAQF:NEWCVS

Test Witness /Review
TEAM LEADER, QUALITY ASSURANCE

Performance Interval
PER VEH, AS REQ

Type of Test Report
COMPUTER PRINT-OUT

Supersedes
NEW

Report Distribution
QUALITY ASSURANCE, DATA VALIDATION, CERT BRANCH

Superseded by

REMARKS/COMMENTS

1.0 The sample analysis of the HWFET is essentially the same as in procedure TP-707 with the following exceptions.

1.1 Only one background and one sample bag is analyzed. (Bag 1 entry on form #707-01.)

1.2 $CO_2$ will be measured on the upper two-thirds of the selected range.

1.3 Fuel economy is calculated from the composite results using program SAQF:NEWCVS.

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Program Mgmt | Quality Assurance | | |
| Lab Branch | Chief | | |
| Lab Branch | Test Operations Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

## CONSTANT VOLUME SAMPLER (CVS) DATA SHEET

MANF CODE | MODEL | VEHICLE I D | MOD YR | DISPL | INERTIA WEIGHT | CURB WEIGHT | NO CYL | H P | ACTUAL DYNO H P | A/C | UTILITY | TRANS | SHIFT PAT | TEST YEAR | TEST TYPE | CARD 0 1 | TRAIN | TEST NO
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

MANUFACTURER SPECS — MANUFACTURER DATA
AXLE RATIO | N/V RATIO | BORE | STROKE | C R | IGN TIMING @ | RPM | % CO | GEAR | IDLE RPM | HC | CO | NOX | EVAP | TIRES SIZE | RIM | DRIVING CYCLE | SOURCE CODE | 0 2 | TRAIN | TEST NO
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

REQUESTOR INIT | BRANCH | REQUESTED DATE | FUEL INJ | SHUT | # CARB | # BBLS | CARB MODEL | EXHAUST SYSTEM TYPES | NAME | EVAP SYS | ENG TYPE | CRANK-CASE | FUEL TYPE | FUEL TANK NO | MAINT CODE | GVW | 0 3 | TRAIN | TEST NO
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

REQUESTOR COMMENTS | EPA CODE | YR | 0 4 | TRAIN | TEST NO

LABORATORY COMMENTS | CVS HOURS | 0 5 | TEST NO

TEST DATE | ODOMETER | IND H P | BAROMETER "HG | TEMP, °F DRY | WET | CVS | MANOMETER SPEC GR | UNITS | CVS PRES IN | OUT | INITIALS OPER | DRIVER | DYNO NO. | CVS UNIT | 0 6 | TRAIN | TEST NO
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

**BAG 1**

BACKGROUND AIR SAMPLE
HC | CO | CO$_2$ | NOX | CURVE RANGE HC | CO | CO$_2$ | NOX | MILEAGE | COUNTS | SECONDS | 0 7 | TRAIN | TEST NO
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

VEHICLE EXHAUST SAMPLE
HC | CO | CO$_2$ | NOX | HC | CO | CO$_2$ | NOX | IGN TIMING @ | RPM | % CO | GEAR | IDLE RPM | 0 8 | TRAIN | TEST NO
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

**BAG 2**

BACKGROUND AIR SAMPLE
HC | CO | CO$_2$ | NOX | HC | CO | CO$_2$ | NOX | MILEAGE | COUNTS | SECONDS | 0 9 | TRAIN | TEST NO
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

VEHICLE EXHAUST SAMPLE
HC | CO | CO$_2$ | NOX | HC | CO | CO$_2$ | NOX | DILUTION AIR, °F DRY | WET | TIRE PRESS | 1 0 | TRAIN | TEST NO
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

**BAG 3**

BACKGROUND AIR SAMPLE
HC | CO | CO$_2$ | NOX | HC | CO | CO$_2$ | NOX | MILEAGE | COUNTS | SECONDS | 1 1 | TRAIN | TEST NO
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

VEHICLE EXHAUST SAMPLE
HC | CO | CO$_2$ | NOX | HC | CO | CO$_2$ | NOX | FUEL WT, KG BEFORE | AFTER | EVAP LOSS GMS | 1 2 | TRAIN | TEST NO
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

04-10-74

Form 707-01

```
CODE  EQUIVALENCE
----  -----------
CARD 1
------
MANF CODE (COLS 1-3)
--------------------
010   AMERICAN MOTORS
021   (CHRYS) CHRYSLER
022   (CHRYS) DODGE
023   (CHRYS) PLYMOUTH
031   (FO MO CO) FORD
032   (FO MO CO) LINCOLN
033   (FO MO CO) MERCURY
041   (GM) BUICK
042   (GM) CADILLAC
043   (GM) CHEVROLET
044   (GM) OLDSMOBILE
045   (GM) PONTIAC
046   (GM) GMC
047   (GM) DETROIT DIESEL
050   ABARTH
060   A C CARS
064   AICHI
070   ASTON MARTIN
080   AUTO CAR
085   AUTO SPORT
090   ALFA ROMEO
095   AM GENERAL
100   AVANTI
105   AUBURN
110   AUSTIN MORRIS (BLMC)
120   BMW
125   BOLWELL
130   BRISTOL
135   BRICKLIN
140   CHECKER
150   CITROEN
160   COMMER
170   SAMCO (CORD)
175   DACIA (ARO)
180   DAF
190   DAIHATSU
200   MERCEDES BENZ
205   DE TOMASO
210   DUAL GHAI
215   DYNA TRUCK
220   FERRARI
230   FIAT
240   FORD OF ENGLAND
245   FORD OF GERMANY
250   HINO
255   HARLEY-DAVIDSON
260   HONDA
270   IHC
280   ISO
290   ISUZU
300   JAGUAR (BLMC)
310   JENSEN
320   JOHN FITCH
330   JEEP (KAISER)
340   LANCIA
350   LOTUS
360   MASERATI
365   MOHS
370   MORGAN
380   NISSAN
390   NSU
400   OPEL
405   PANTHER
410   PEUGEOT
420   PORSCHE
430   RENAULT
440   ROLLS-ROYCE
450   ROOTES
460   ROVER (BLMC)
470   SAAB
480   SHELBY
490   MITSUBISHI
495   SIATRA
500   SIMCA
510   SKODA
520   SS AUTOMOBILE
530   TRIUMPH (BLMC)
535   STUTZ
540   SUZUKI
550   TORINO
560   TOYO KOGYO
570   TOYOTA
580   VAUXHALL
590   VOLKSWAGEN
600   VOLVO
605   WHITE
610   YENKO
615   YAMAHA
620   TVR
630   SUSPENSIONS INT (OMEGA)
640   AUDI
650   MURENA MOTORS
660   FUJI HEAVY IND

CODE  EQUIVALENCE
----  -----------
670   MONTEVERDI
680   INTERMECCANICA (ITALIA)
690   LAMBORGHINI
700   MARCOS
710   ARMY
720   WINNEBAGO
725   ALLIS CHALMERS
730   CATERPILLAR
740   CUMMINS
750   HERCULES
760   MACK
770   PERKINS
780   SCANIA-VABIS
790   CLASSIC
800   TELEDYNE CONTINENTAL
810   CASE
820   DIAMOND REO
830   HIGHWAY PRODUCTS,INC
999   EXPERIMENTAL

AIR CONDITIONING (COL 61)
-------------------------
  1   WITH
  2   WITHOUT

UTILITY VEHICLE (COL 62)
------------------------
  1   YES
  2   NO

TRANSMISSION (COL 63)
---------------------
  1   AUTO
  2   3-SPEED
  3   4-SPEED
  4   5-SPEED
  5   SEMI-AUTOMATIC

SHIFT PATTERN (COL 64)
----------------------
  1   STANDARD
  2   OPTIONAL

TEST TYPE (COLS 69-70)
----------------------
 00   VOID
 01   CERT (EMISSION DATA)
 02   CERT (DURABILITY)
 03   CERT (CORRELATION)
 04   SURVEILLANCE
 05   EXPERIMENTAL
 06   FIELD SURVEILLANCE
 07   PARTICULATES
 08   OTHER
 09   CVS CORRELATION
 10   RESEARCH
 11   CORRELATION (LAB)
 12   CERT (RUNNING CHANGE)

TRAIN (COLS 74-75)
------------------
 1-97 [illegible]
 98   PARTICULATES
 99   PROP SAMPLER

CARD 2
------
DRIVING CYCLE (COL 67)
----------------------
  1   7-MODE
  2   LA-4
  3   LA-4 S3
  4   ANN ARBOR
  5   LA-4 S4
  6   9 X 7 MODE
  7   STEADY STATE
  8   OTHER

SOURCE CODE (COLS 69-70)
------------------------
 01   MANUFACTURER
 02   HERTZ DETROIT
 03   HERTZ L.A.
 04   AVIS
 05   AIRWAYS CORP L.A.
 06   ALPH CORP L.A.
 07   GSA L.A.
 08   PO DEPT DETROIT
 09   PO DEPT L.A.
 10   L.A. COUNTY VEH
 11   STATE OF CALIFORNIA
 12   BORROWED FROM CORPS
 13   AMERICAN RACEWAYS, INC
 14   DEALER USED CARS
 15   EPA
 16   GSA
 17   MILITARY

CODE  EQUIVALENCE
----  -----------
 18   PRIVATE OWNER
 19   OTHER

CARD 3
------
FUEL INJECTION (COL 13)
-----------------------
  1   YES
  2   NO

FUEL SHUTOFF (COL 14)
---------------------
  1   YES
  2   NO

EXHAUST SYSTEM TYPE (COLS 27-28),
---------------------------------
 (COLS 29-30),(COLS 31-32),
 --------------------------
 (COLS 33-34) AND (COLS 35-36)
 -----------------------------
 01   AIR INJECTION
 02   ENGINE MOD
 03   FUEL INJECTION
 04   OTHER
 05   THERMAL REACTOR
 06   CATALYTIC REACTOR
 07   TURBOCHARGER
 08   EXHAUST RECYCLE
 09   NONE

EVAP SYSTEM TYPE (COLS 47-48)
-----------------------------
 01   CRANKCASE
 02   CANISTER
 03   TANK
 04   NONE

ENGINE TYPE (COLS 50-51)
------------------------
 01   I-BLOCK
 02   V-BLOCK
 03   ROTARY
 04   OPPOSED
 05   TURBINE
 06   EX (STEAM)
 07   EX (FREON)
 08   DIESEL
 09   STIRLING
 10   ELECTRIC
 11   STRATIFIED

CRANKCASE SYSTEM TYPE (COL 53)
------------------------------
  1   CLOSED
  2   OTHER

FUEL TYPE (COLS 55-56)
----------------------
 01   INDOLENE 30
 02   COMMERCIAL LEADED
 03   LPG
 04   PROPANE
 05   OTHER
 06   IND UNLEADED, 91 OCT
 07   IND UNLEADED, 100 OCT
 08   #1 FUEL OIL
 09   #2 FUEL OIL
 10   NATURAL GAS
 11   ALCOHOL
 12   INDOLENE 10
 13   INDOLENE 20
 14   JP-4
 15   KEROSENE
 16   COMMERCIAL UNLEADED

MAINTENANCE CODE (COL 61)
-------------------------
  1   BEFORE
  2   AFTER
  3   NORMAL

ODOMETER CODE (COL 62)
----------------------
  1   MILES
  2   KMS

CARD 6
-------
MANOMETER UNITS (COLS 43-44)
----------------------------
 IN   INCHES
 CM   CENTIMETERS
 MM   MILLIMETERS
```

Form 707-01 (cont.)

ANALYZER [illegible] READ OUT

TEST NO. ________ MFG ____________________ DATE ________

| BAG | HC | R | CO | R | $CO_2$ | R | NOx | R | |
|---|---|---|---|---|---|---|---|---|---|
| B/G 1 | | | | | | | | | |
| SAM. 3 | | | | | | | | | |
| B/G 2 | | | | | | | | | |
| SAM. 4 | | | | | | | | | |
| B/G 1 | | | | | | | | | |
| SAM 3 | | | | | | | | | |

OPERATOR REMARKS: ____________________

TEST NO. ________ MFG ____________________ DATE ________

| BAG | HC | R | CO | R | $CO_2$ | R | NOx | R | |
|---|---|---|---|---|---|---|---|---|---|
| B/G 1. | | | | | | | | | |
| SAM. 3 | | | | | | | | | |
| B/G 2 | | | | | | | | | |
| SAM 4 | | | | | | | | | |
| B/G 1 | | | | | | | | | |
| SAM 3 | | | | | | | | | |

OPERATOR REMARKS: ____________________

```
TEST # 16-7167                    1975          FUEL ECONOMY CYCLE
                                                                          PROCESSED: 14:25:46  JAN  3, 1975
 MFG.                                   MOD.           INERTIA   CURB      NO.          ACTUAL     A                         TEST  TEST
CODE      MODEL         VEHICLE I.D.    YR    DISPL.   WEIGHT    WEIGHT    CYL.  H.P.  DYNO.H.P.  C  UTL  TRANS  S.PAT.    YEAR  TYPE
 999  TCCS CRICKET      776-007          72    141.0    2500        0        4     0      0.0     2   2     1      1        75     5

                         IND.     BARO  /----TEMP.,OF---------/----MANOMETER---/-----CVS PRES.----/---INITIALS---/  DYNO. CVS
TEST DATE  ODOMETER      H.P.     "HG       DRY    WET    CVS    SPEC.GR. UNITS      IN      OUT       OPER.  DRIVER     NO.  UNIT
 1- 3-75      6034.      6.2      28.86     74.4   57.7   99.5     1.75   IN      24.90    17.25       CFJ     TAT       08    7C
                                DILUTION AIR  0.0    0.0

  CUBIC FT    CALCULATED     NOX          IGN                            IDLE    EVAP. LOSS   TIRE
  PER REV.       RPM        FACTOR       TIMING     PPM   % CO    GEAR    RPM       GRAMS     PRES.
  0.27028       1454.       0.8502                   0.    0.0             0.       AA.AA     45.0

BAG 1    10.225 MILES   1-530. COUNTS   4073.5 CU. FT.    765.3 SECONDS   D/FACTOR=10.192 ACT RPM= 1460.6 RPM RATIO(C/A)=0.9953
                   EXHAUST SAMPLE             BACKGROUND SAMPLE          CORRECTED           MASS EMISSIONS
               RANGE   METER      CONC.   RANGE   METER     CONC.   CONCENTRATIONS      GMS          GMS/MI        MPG1
  HC-FID         4     33.8      101.56     4       1.7      5.02       97.03 PPM        6.45         0.63
  CO             3     20.5        9.61     3       0.0      0.0         9.61 PPM        1.29         0.13
  CO2            2     46.2        1.304    2       1.5      0.041       1.267 %      2676.08       261.72         33.6
  NOX CHEM       4     56.2       56.20     4       0.5      0.50       55.75 PPM       10.46         1.02
```

# Section 800

# DATA VALIDATION

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| | | |
|---|---|---|
| **EPA TEST PROCEDURE** | Number TP-801 | Page 1 of 11 |

| | |
|---|---|
| SUBJECT<br>DATA VALIDATION | |
| Reference<br>EPA, ANN ARBOR, DRAFT "LIGHT DUTY TEST OPERATIONS | Data Form No.<br>SEE SECTION 2.0 |
| Responsible Organization<br>TEST OPERATIONS | Computer Program<br>SEE SECTION 10.0 |
| Test Witness /Review MANUFACTURER'S REPRESENTATIVE/ CERTIFICATION BRANCH REPRESENTATIVE | Performance Interval<br>PER VEHICLE |
| Type of Test Report FINAL COMPUTER OUT-PUT OF EMISSION DATA AND COMPILED VEHICLE FILE | Supersedes<br>NEW |
| Report Distribution QUALITY ASSURANCE, CERTIFICATION BRANCH, MANUFACTURER'S REPRESENTATIVE, TEST OPERATIONS, | Superseded by |

REMARKS/COMMENTS DATA VALIDATION, PRODUCTION CONTROL

ORIGINAL RELEASE APPROVALS

| Office | Section | Signature | Date |
|---|---|---|---|
| Division Direc | Quality Assurance | | |
| Lab Branch | Chief | | |
| Lab Branch | Test Operations Chief | | |
| | | | |
| | | | |

REVISIONS

| Change Letter | Description of Change | Approval | Date |
|---|---|---|---|
| | | | |

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## 1.0 PURPOSE

Data Validation establishes a control network to assure a smooth flow of all data collected from Production Control (scheduling) and Test Operations (Acceptance, Pre-conditioning/Prep, FTP and HWFET). The Data Validation section will also check the data form to confirm the validity of the results and assure the data is within specified limits.

## 2.0 TEST ARTICLE DESCRIPTION

2.1 The following data sheets, chart traces and reports are required for a complete Data Validation system.

- Form 701-01, Driver's Preconditioning Report.
- Form 705-01, Vehicle Test and Evaporative Data Sheet
- Form 705-02, Evaporative Emissions Data Sheet
- Form 707-01, CVS Data Sheet
- Form 707-02, Analyzer read-out (FTP and HWFET)
- FTP driver's trace
- FTP analyzer traces
- CVS temperature trace
- Diurnal temperature trace
- Preliminary results
- Official values (1 each)
- Official values (2 each)
- CVS Data Sheet (blue copy), form 707-01
- Form 707-01, HWFET CVS Data Sheet
- HWFET re-test (if necessary)
- HWFET clearance
- HWFET driver's trace
- HWFET preliminary results
- Form 801-01, Weekly activity report
- Data processing job request

## 3.0 REFERENCES

3.1 EPA, Ann Arbor, Draft, "Light Duty Test Operations"

3.2 "Test Validation Procedures," Joe Belanger, EPA, Ann Arbor, 30 September 1974.

## 4.0 REQUIRED EQUIPMENT

4.1 Validation stamps

## 5.0 PRECAUTIONS

5.1 Not applicable.

## 6.0 VISUAL INSPECTION

6.1 Contained in Section 8.0

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7.0 TEST ARTICLE PREPARATION

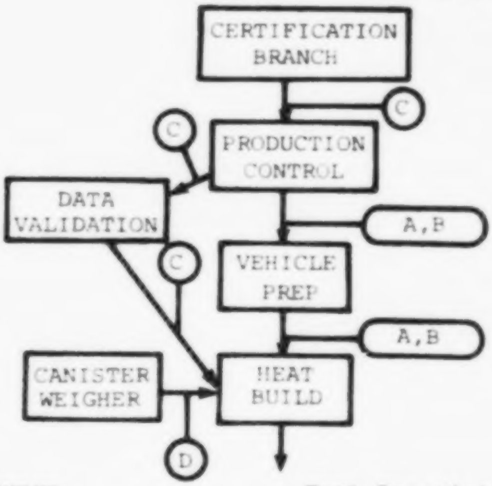
7.1 All forms and traces must be complete before submittal to Data Validation.

## 8.0 TEST PROCEDURE

The procedures for Test Data Validation serve a multi-purpose. First, they illustrate the functional flow of the paperwork system and the sequence of tests. Finally, it is a system for checking the validity of the test data itself.

The procedures are divided into five sections, in order to ease interpretation of the sequence. Each section has a mini-flow diagram to further illustrate the steps to be followed.

### SECTION I



A. Form 705-01

B. Form 701-01

C. Form 707-01

D. Form 705-02

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 101 | Certification Branch representative and the Manufacturer's Representative initiate a test request. | |
| 102 | The request (CVS data sheet) is sent to Production Control for scheduling. | |
| 103 | The CVS Data Sheet (707-01) are picked up daily from Production Control by the Data Validation section along with the daily test schedule and test number assignments. | |
| 104 | The following information is recorded on form #707-01 by Data Validation and the form is placed on the corresponding test vehicle. | |

- o Date
- o Odometer reading
- o Manometer specific gravity
- o Test cycle mileage(s)
- o Tire pressure
- o Timing, RPM, % CO (idle) and idle RPM

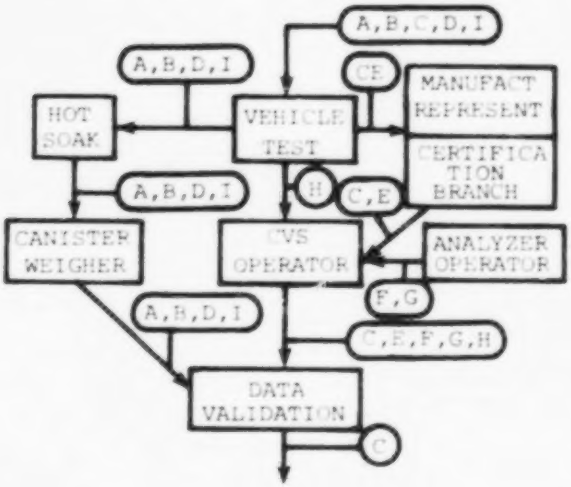
Test Sequence | Test Description | Data Output

105 The test number is also recorded on forms #701-01, 705-01 and 705-02.

106 Twenty copies of the daily schedule are distributed as follows:

- 1 copy each: Data Branch
  Certification Branch
  Team Leaders
  Each Analyzer Train
  Posted on Soak billboard
- 1 copy and the original to Production Control.
- 3 copies remain in Data Validation
- 7 copies to lab technicians

## SECTION II


A,B,C,D,I
A,B,D,I
CE
HOT SOAK
VEHICLE TEST
MANUFACT REPRESENT
CERTIFICATION BRANCH
A,B,D,I
H
C,E
CANISTER WEIGHER
CVS OPERATOR
ANALYZER OPERATOR
F,G
A,B,D,I
C,E,F,G,H
DATA VALIDATION
C

A.- D. See Sec. I

E. Driver's Trace

F. Analyzer Traces

G. Form 707-02

H. CVS Temp. Trace

I. Diurnal/Hot Soak Trace(s)

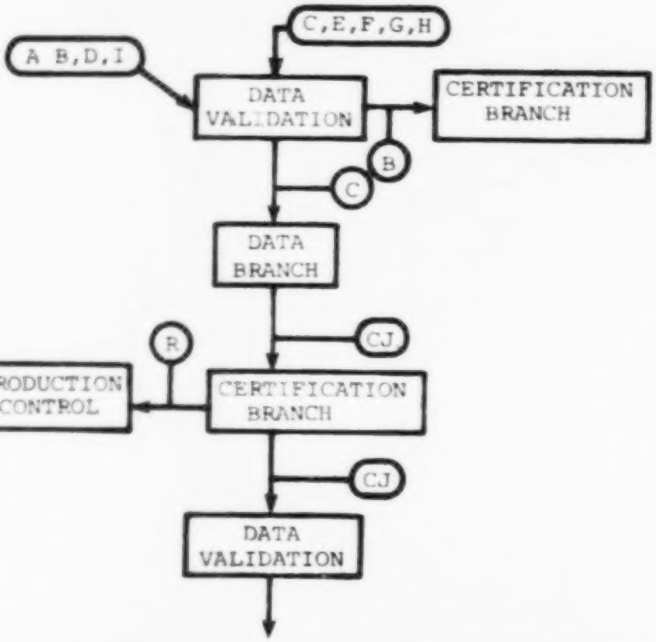
Test Sequence | Test Description | Data Output

201 During the 1975 Mass Emissions Test, the CVS Operator records the following on form #707-01.

- Indicated horsepower $I_{hp}$
- Barometric pressure Baro.

| Test Sequence | Test Description | Data Output |
|---|---|---|
| | o Wet and Dry bulb temperature | $W_B$, $D_B$ |
| | o CVS temperature | Inlet Temp. |
| | o CVS pump inlet and outlet pressure | $P_{IN}$, $P_{OUT}$ |
| | o Operator and driver's initials | Initials |
| | o Rev. counts and seconds | Revs, Secs |
| | o CVS hours | Hours |
| | o Analyzer train number | Number |
| 202 | The driver's trace and analyzer traces generated during the test are checked by the Manufacturer's Representative and the Certification Branch representative and signed as "valid" or "invalid." | Valid<br>Invalid |
| 203 | The CVS operator delivers the traces and form 707-01 to Data Validation. | |
| 204 | Following the Mass Emission Test and hot soak evaporative, the remaining documentation is taken to the canister weigher. After recording evap. results, he delivers all documentation to Data Validation. | |

## SECTION III


C,E,F,G,H
A B,D,I
DATA VALIDATION
CERTIFICATION BRANCH
B
C
DATA BRANCH
CJ
R
PRODUCTION CONTROL
CERTIFICATION BRANCH
CJ
DATA VALIDATION

A. - I. See Sec. I and II

J. Preliminary Results

R. HWFET Clearance

**REVISIONS:**

DATA VALIDATION

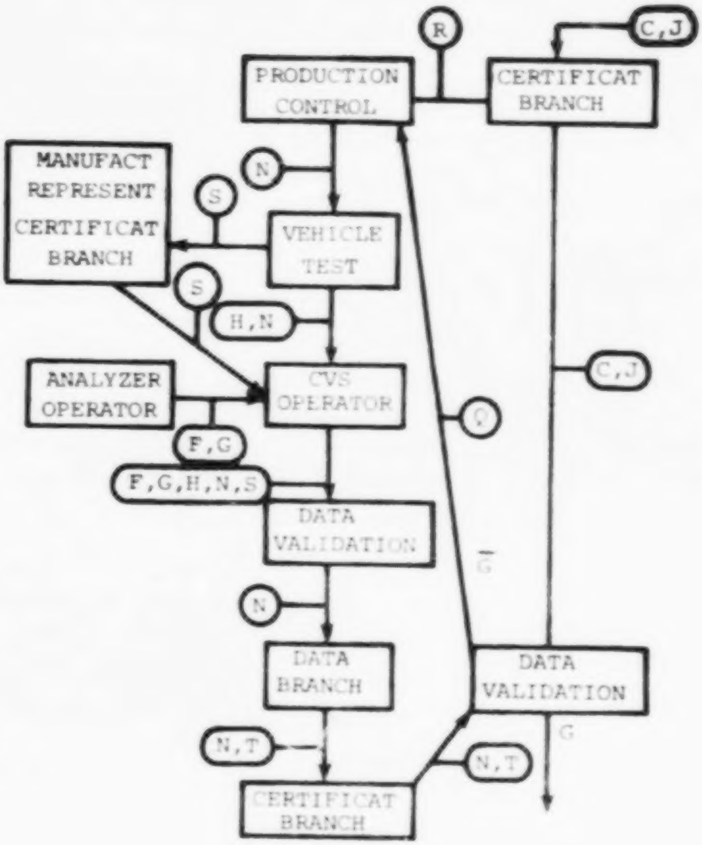
**TEST PROCEDURE**

**PROCEDURE NO.** TP-801

**PAGE** 7 **OF** 11

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 301 | Data Validation receives all documentation from the CVS operator and canister weigher following the FTP and makes a file envelope for each test. | |
| 302 | The analyzer traces are checked for proper procedure and the chart values are compared with those logged on the analyzer read-out form. | |
| 303 | The concentration values are transcribed onto the CVS data sheet and all other entries are audited for obvious errors. | |
| 304 | The CVS data sheet is taken to the Data Branch (data processing job request required) for preliminary result analysis. | |
| 305 | The Certification Branch representative obtains the CVS data sheet and preliminary results from the Data Branch. The results are checked and if it is a data vehicle, Production Control is given clearance for the HWFET. The representative then logs HWFET at bottom of CVS data sheet. | |
| 306 | After the preliminary results and form #707-01 (CVS) is received from the Certification Branch representative, Data Validation section compares the results of the preliminary print-out with the analyzer read. Errors, if any, are corrected and the corrected data sheet is re-routed to the Data Branch for a new print-out. | |
| 307 | Data Validation checks off the remaining documentation and places it in the appropriate file. | |

## SECTION IV

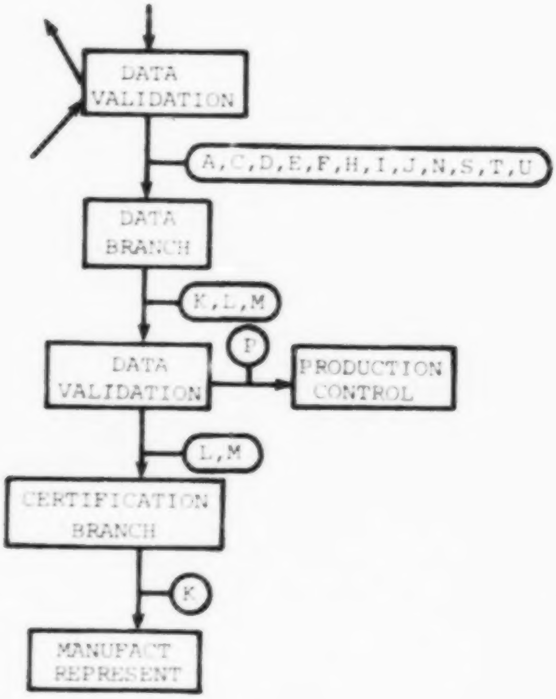

R
C,J
PRODUCTION CONTROL
CERTIFICAT BRANCH
MANUFACT REPRESENT
CERTIFICAT BRANCH
N
S
VEHICLE TEST
S
H,N
ANALYZER OPERATOR
CVS OPERATOR
F,G
C,J
Q
F,G,H,N,S
DATA VALIDATION
$\overline{G}$
N
DATA BRANCH
DATA VALIDATION
G
N,T
N,T
CERTIFICAT BRANCH

C. Form 707-01
F. Analyzer Traces
G. Form 707-02
H. CVS Temp. Trace
J. Preliminary Results
N. Form 707-01
Q. HWFET re-test
R. HWFET clearance
S. HWFET driver's trace
T. HWFET preliminary results

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 401 | The Certification Branch representative receives the preliminary FTP results from the Data Branch, checks it and clears for HWFET. Production Control initiates the HWFET. | |
| 402 | Upon completion of the HWFET, the results are submitted to Data Validation by the CVS operator. | |
| 403 | The analyzer traces are checked for errors and the concentrations are entered onto form #707-01 (HWFET CVS). The form is screened for obvious errors and submitted to the Data Branch for preliminary analysis. | |

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 404 | The supporting documentation is checked off and entered into the FTP file for the vehicle. | |
| 405 | The Certification Branch representative obtains the HWFET preliminary results from the Data Branch. If the results are accepted as valid, the representative delivers the results to Data Validation. | |
| 405A | If the results are rejected, the HWFET data sheet is replaced and Production Control schedules a re-test. | |

## SECTION V


DATA VALIDATION
A,C,D,E,F,H,I,J,N,S,T,U
DATA BRANCH
K,L,M
P
DATA VALIDATION
PRODUCTION CONTROL
L,M
CERTIFICATION BRANCH
K
MANUFACT REPRESENT

A. Form 705-01
B. Form 707-01
C. Form 705-01
E. Driver's trace
F. Analyzer traces
H. Temp. Trace, CVS
I. Diurnal temp. trace
J. Preliminary results
K. Official values (1 each)
L. Official values (2 each)
M. Form 707-01 (blue copy)
N. Form 707-01
P. Form 801-01
S. HWFET driver's trace
T. HWFET preliminary results
U. Data processing job request

| Test Sequence | Test Description | Data Output |
|---|---|---|
| 501 | Data Validation packages all documentation and preliminary results from the FTP and HWFET (if applicable) in file envelopes. The complete file is sent to the Data Branch for final processing. | |
| 502 | Following final processing, three copies of the official values print-out and the blue copy of form #707-01 are returned to Data Validation. | |
| 503 | Data Validation performs a final check to assure no obvious errors exist. The print-outs are marked with the official value stamp and two copies plus the blue CVS data sheet are delivered to the Certification Branch. The third copy is retained in the vehicle file. | |
| 504 | The Certification Branch retains one copy of the official values and the blue copy of form #707-01 in their file. One copy of the official values is sent to the Manufacturer's Representative. | |
| 505 | The weekly activity report, form #801-01, is compiled and sent to Production Control by 4:00 p.m. each Monday. One copy is sent to Test Operations file and one is retained in the Data Validation file. | |

## 9.0 DATA INPUT

9.1 This information is contained in Section 8.0.

## 10.0 DATA ANALYSIS

10.1 Analysis is performed by the Data Branch using the following computer programs.

- 1975 SAQF:NEWCVS-FTP
- SAQF:NEWCVS-HWFET

## 11.0 DATA OUTPUT

11.1 This information is contained in Section 8.0.

## 12.0 ACCEPTANCE CRITERIA

12.1 Acceptance criteria for data input to the Data Validation section is explained in previous procedures. For acceptance limits reference Section 12.0 of the following procedures.

12.1.1 Evaps - Procedure TP-705 and TP-708

12.1.2 Prep. and Preconditioning - Procedure TP-702 and TP-703

12.1.3 Urban dyno test - Procedure TP-706 and TP-707

12.1.4 HWFET - Procedure TP-710, TP-711 and TP-712

## 13.0 QUALITY PROVISIONS

13.1 The Q.A. Department should audit final results to assure all entries and results are within acceptable limits.

13.2 A statistical inference study should also be made of typical problems and solutions from data compiled in the vehicle files. This study can be performed by using control charts, analysis of variance, and error analysis techniques.

## F.T.P. MINUS EVAP PLUS F.E.T.

## DRIVER'S PRECONDITIONING REPORT

Vehicle mfgr. ______________________ No. ______________________

Time Out ______________ Time In ______________ Odom ______________

Date ______________________ Test# ______________________

### I. VEHICLE INSPECTION

A. Valid License Plate ☐ OK ☐ None

B. Exhaust Adaptor ☐ OK ☐ None

C. Fuel Drain ☐ OK ☐ None

D. Vehicle Damage (note on reverse) ☐ OK ☐ Note

E. Equip. not connected notify Prod. Cont. ☐ OK ☐ Note

F. Mfgr's Data Sheet ☐ OK ☐ Non

G. Oil level; if low notify Prod. Cont. ☐ OK ☐ Not

H. Odom Reading ☐ OK

I. Fuel level, 1/4-tank min,; add if required.

J. Start-up per Mfg. instructions ☐ OK

K. Drive AMA route ☐ OK

### II. AMA PRECONDITIONING

A. Engine Start ☐ Good ☐ Hard ☐ False

B. Ignition Switch ☐ OK ☐ Other

C. Starter Motor ☐ OK ☐ Grinds ☐ No Start

D. Fast Idle ☐ OK ☐ None ☐ Engine Hot

E. Transmission ☐ OK ☐ Shifts Hard

F. Clutch ☐ OK Grabs ☐ Slips ☐ N/A

G. Brakes ☐ OK Fade ☐ Poor ☐ None

H. Driveability ☐ Surge ☐ Stumble ☐ Back Fire ☐ Stretchy
Engine Miss ☐ Diesels ☐
☐ OK

Driver's Signature ______________________________

Form 701-01

---

## II. SPECIFICATION CHECK

**INITIAL**

A. Idle CO Rt________% Lt________% ________

B. Engine RPM Idle______ Drive______ ________

C. Ignition Timing __________@__________in D☐/N☐ ________

D. Fuel Drain ________

E. Wheel to driveshaft ratio
10 wheel turns to __________driveshaft revs. N/V____ ________

F. Tire size _______x_______. ________

G. Vehicle Weight __________with _________ tank fuel ________

H. Add 40% evap. fuel. Witness Sig. _____________ ____________

---

## IV. DYNAMOMETER HOT LA-4

A. Drive vehicle onto dyno.
Set inertia ______lbs. @___________H.P.

B. Check Varian. ☐Paper-OK ☐Pen-OK ☐Ink-OK ☐Zero-OK

C. Start Cooling Fan ☐OK ☐Release Dyno Brake-OK
☐Tire Pressure 45 P.S.I.-OK

D. Hook-up ☐Chock Blocks-OK ☐Cable Winch ☐Exhaust

E. Drive to Soak Area per schedule.

F. 11-Hour Soak Start __________________ (DO NOT RE-START ENGINE AFTER SHUT DOWN).

G. DO NOT START TEST BEFORE ___________AM/PM. (Add 11 hours to hot soak start time).

Technician's Signature______________ ______________________________

Leader/Supv. Signature______________ ______________________________

## VEHICLE TEST AND EVAPORATIVE DATA

Vehicle Mfgr.________________________ No.________________

Inertia Wt.________ HP________ A/C________ Test #________

---

### I. HEAT BUILD

| | TECH | CTA |
|---|---|---|
| A. Drain fuel | ☐ | ☐ |
| B. Plumb air cleaner | ☐ | ☐ |
| C. Plumb canister | ☐ | ☐ |
| D. Plumb bowl vent (if required) | ☐ | ☐ |
| E. Trap gas cap (if required) | ☐ | ☐ |
| F. Seal orifices/vents | ☐ | ☐ |
| G. Install carbon traps (record on data sheet) | ☐ | ☐ |
| H. Hook-up temperature recorder | ☐ | ☐ |
| I. Hook-up thermocouple leads | ☐ | ☐ |
| J. Install heat blanket | ☐ | ☐ |
| K. Plug in fuel tank heater (when used) | ☐ | ☐ |
| L. Refuel vehicle - 40% of tank capacity | ☐ | ☐ |

Tech. Sig.________________ Witness Sig.________________

| | TECH | CTA |
|---|---|---|
| M. Replace fuel cap, plug exhaust pipe(s) Unclamp canister | ☐ | ☐ |

| Heat Build Progress | Fuel Temp. Lead No. 1 | Fuel Temp. Lead No. 4 | Ambient Temp. |
|---|---|---|---|
| 0-Min. | | | |
| 15-Min. | | | |
| 30-Min. | | | |
| 45-Min. | | | |
| 60-Min. | | | |

---

### II. DYNAMOMETER WARM-UP/SET

A. Drive non-test vehicle onto dyno B. Hook-up vehicle as for Hot LA-
C. Set inertia______lbs.@______H.P. D. Drive @50mph steady state
E. Remove vehicle from dyno

I. Tech. Sig.________________________ Date____________

II. Tech. Sig.________________________ Date____________

FORM 705-01

## III MASS EXHAUST EMISSIONS TEST

A. Check Varian Paper-OK☐ Pen-OK☐ Ink-OK☐ Zero-OK☐

B. Cooling fan in place OK☐ Release dyno brake-OK ☐

C. Hook up Chock blocks-OK ☐ Cable winch☐ Exhaust ☐

D. Temp. recorder Connect thermocouple leads☐ Start recorder ☐

E. CVS Check fan operation☐ Bags-OK ☐ Rev. Ctr. Zero ☐
Leak check-OK ☐ CVS Temp-OK ☐
Cell temp-OK ☐ Return to sample ☐

F. Drive test trace ☐ Check tire pressure (45 PSI) ☐

G. Remove vehicle to Soak Area ☐

---

## IV. HOT SOAK EVAPORATIVE EMISSIONS TEST

| | TECH | CTA |
|---|---|---|
| A. Reseal orifices/vents | ☐ | ☐ |
| B. Reconnect carbon canisters and unclamp | ☐ | ☐ |
| C. Reconnect temp. recorder and thermocouple leads | ☐ | ☐ |
| D. Check gas cap | ☐ | ☐ |
| E. Plug exhaust pipe(s) | ☐ | ☐ |
| F. 1-hour soak Start time______ End______ | ☐ | ☐ |
| G. Start amb. temp.______ End amp. temp.______ | ☐ | ☐ |
| H. Check ambient temp. at 15-min. intervals | ☐ | ☐ |
| I. End of hot soak - reclamp canisters and remove | ☐ | ☐ |
| J. Shut-off temp. recorder | ☐ | ☐ |
| K. Weigh canisters and record on data sheet | ☐ | ☐ |

---

## V. DE-PREP AND VEHICLE REMOVAL

| | | |
|---|---|---|
| A. Remove all collection tubing, exhaust pipe plug(s), orifice/vent plugs, tape, foil, etc. | ☐ | ☐ |
| B. Disconnect temp. recorder & thermocouple leads | ☐ | ☐ |
| C. Return engine to Mfgr's running configuration | ☐ | ☐ |
| D. Move vehicle to East lot - keys to Prod. Contr. | ☐ | ☐ |
| E. "VOID" or "FAILED" vehicles - check with Team Leader for disposition | | |
| F. Leave as is, if acceptable for HWFET | | |

III. Tech. Sig.________________________ Date__________

IV. Tech. Sig.________________________ Date__________

V. Tech. Sig.________________________ Date__________

## EVAPORATIVE EMISSION WEIGHING DATA

TEST NO. ____________________

DATE ____________________

MAKE OF CAR ____________________

| | | | | |
|---|---|---|---|---|
| CANISTER NO | | | | |
| CANISTER LOCATION | | | | |
| HOT SOAK WEIGHT | | | | |
| INITIAL WEIGHT | | | | |
| EVAP. EMISSIONS | | | | |

TOTAL EVAP. EMISSIONS ____________________

FORM 705-02

# CONSTANT VOLUME SAMPLER (CVS) DATA SHEET

MANF CODE | MODEL | VEHICLE I.D. | MOD YR | DISPL | INERTIA WEIGHT | CURB WEIGHT | NO CYL | H.P. | ACTUAL DYNO H.P. | A/C | UTILITY | TRANS | SHIFT PAT | TEST YEAR | TEST TYPE | CRD | TRAIN | TEST NO

MANUFACTURER SPECS: AXLE RATIO | N/V RATIO | BORE | STROKE | C.R. | IGN TIMING | RPM | % CO | IDLE RPM | MANUFACTURER DATA: HC | CO | NOx | EVAP | TIRES: SIZE | PSI | DRIVING CYCLE | SOURCE CODE | TRAIN | TEST NO

REQUESTOR: INIT | BRANCH | REQUESTED DATE | FUEL | CARB MODEL | EXHAUST SYSTEM: TYPES | NAME | ENG TYPE | TRANS CASE | FUEL TYPE | GVW | TRAIN | TEST NO

REQUESTOR COMMENTS | EPA CODE | YR | TRAIN | TEST NO

LABORATORY COMMENTS | CVS HOURS | TEST NO

TEST DATE | ODOMETER | IND H.P. | BAROMETER HG | TEMP °F: DRY | WET | CVS | MANOMETER: SPEC GR | UNITS | CVS PRES: IN | OUT | INITIALS: OPER | DRIVER | DYNO NO | CVS UNIT | TRAIN | TEST NO

BAG 1

BACKGROUND AIR SAMPLE: HC | CO | CO2 | NOx | CURVE RANGE | MILEAGE | COUNTS | SECONDS | TRAIN | TEST NO

VEHICLE EXHAUST SAMPLE: HC | CO | CO2 | NOx | IGN TIMING | RPM | % CO | IDLE RPM | TRAIN | TEST NO

BAG 2

BACKGROUND AIR SAMPLE: HC | CO | CO2 | NOx | MILEAGE | COUNTS | SECONDS | TRAIN | TEST NO

VEHICLE EXHAUST SAMPLE: HC | CO | CO2 | NOx | DILUTION AIR | WET | TEST NO

BAG 3

BACKGROUND AIR SAMPLE: HC | CO | CO2 | NOx | MILEAGE | COUNTS | SECONDS | TRAIN | TEST NO

VEHICLE EXHAUST SAMPLE: HC | CO | CO2 | NOx | FL WT, KG: BEFORE | AFTER | EVAP LOSS GMS | TRAIN | TEST NO

04 10 74

Form 707-01

# ANALYZER TEST READ-OUT

TEST NO. ________ MFG ____________________ DATE ________

| BAG | HC | R | CO | R | $CO_2$ | R | NOx | R | |
|---|---|---|---|---|---|---|---|---|---|
| B/G 1 | | | | | | | | | |
| SAM. 3 | | | | | | | | | |
| B/G 2 | | | | | | | | | |
| SAM. 4 | | | | | | | | | |
| B/G 1 | | | | | | | | | |
| SAM 3 | | | | | | | | | |

OPERATOR REMARKS: ____________________

TEST NO. ________ MFG ____________________ DATE ________

| BAG | HC | R | CO | R | $CO_2$ | R | NOx | R | |
|---|---|---|---|---|---|---|---|---|---|
| B/G 1. | | | | | | | | | |
| SAM. 3 | | | | | | | | | |
| B/G 2 | | | | | | | | | |
| SAM 4 | | | | | | | | | |
| B/G 1 | | | | | | | | | |
| SAM 3 | | | | | | | | | |

OPERATOR REMARKS: ____________________

form 707-02

Form 801-01

ENVIRONMENTAL PROTECTION AGENCY

Ann Arbor, Michigan 48105

Light Duty Testing Schedule for__________________ Date Submitted__________________

| TEST # | TECH | MANU. OF VEHICLE | VEHICLE I.D. | DYNO # | START | F.E. | TYPE TEST | RE-TEST | VOID |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
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TP-801
Attachment No. 1

**DATA PROCESSING JOB REQUEST** Job No. 01569

Submitted by: ____________________ Branch: ________ Section: ____________

Project number: ____________________

**IN** DATE: __________
TIME: __________

**OUT** DATE: __________
TIME: __________

Completed by: ____________________

Application name: ____________________________

Number of runs: ________

Results needed by: ________________

Additional copies of results: ______

Urgency: ________________________
________________________

Data processing section use

Program name(s): ________________________

Program modifications: ________________________

Special I/O requirements: ________________________

Pre-run preparation: ________________________________

Computer usage: CCU __________

CLT __________

Job No. 01569

NAPCA (DUR) 166
7/70

## Section 900

## PROGRAM PLANNING AND QUALITY AUDIT

Currently no procedures are included in this Section of the manual. Those procedures pertaining to this Section must be supplied by the user and may be supplied by the EPA in subsequent revisions.

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